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The Indian Legislative Chambers.

DEMOCRACY, after all, is government by speeches. In the provinces in which the Congress Ministry is functioning, democracy is in full action. This necessarily implies the making of speeches both within the legislative chambers and outside them. It will be remembered that, during the budget session of the assemblies, the Ministers whose administrative activities and intentions are critically reviewed by the Opposition, have an arduous time in defending their policies and achievements. We have the greatest sympathy for the members of the legislative bodies and the ministers, who, assembled with hostile intentions towards each other's view-points and principles underlying the administration of the country, find in the month of May conditions not propitious for the smooth and speedy transaction of the affairs of the State. The agitation of the House, with frequent exhibitions of temper, alien, however, to the pacific and philosophic disposition of Indian legislators, must be due to the temperature variations from the floor to the ceiling of the chambers, whose atmosphere also becomes charged with dust and dirt, and perhaps also due to the presence of odours resulting from big congregations of people. These are annoying factors. We do not understand the special sanctity attached by the Central and Provincial Governments to the months of March and April, for which, however, popular sentiment, for obvious reasons, does not express any tender solicitude. If the Congress Ministry should order a medical inspection, accompanied by the application of intelligence tests, of all the legislators including the members of the Treasury Bench, before and after the budget session, the results of such investigation will disclose the alarming extent to which the physical and mental efficiency of the legislators has suffered. March and April are not favourable for physical and mental exertion in the tropics, because the thermometer behaves as madly during these months as the winds become capricious. Therefore the ancient Law Givers of India wisely interdicted long travels and arduous mental work, recommending that men should spend these trying months in a kind of semi-æstivation. It is obvious that the efficiency of administration depends upon the health and comfort of the ministers and legislators, and the responsibility of devising the means of keeping them fit devolves naturally upon the electorates.

We know what health is. It is a state of unconsciousness of the body. But human comfort is an illusive thing. Perhaps it is

successfully accomplished if we can dispense with the necessity for any physiological adjustment of our bodies to our external environment. When the human organism reacts violently to the atmospheric conditions, such as capricious fluctuations of temperature, moisture, dust, and offensive odours, then these reactions attract our attention, which in the interests of public service should not be diverted from the transaction of legislative business. Comfort depends upon the heat control mechanisms of the body and upon the digestive apparatus functioning insensibly, and the sensory organs receiving continuous pleasant stimulation. Do the legislative chambers provide such conditions as would promote the health and comfort of the legislators and maintain their efficiency for public service? Suppose all the Houses of Assembly and Council Chambers are air conditioned, and the food and places of residence of the members of legislature are medically controlled and supervised, in a way calculated to promote their health and comfort during the session, can we not reasonably hope for better service to the country? We are definitely of opinion that the progress of the country entirely depends on the healthy digestion of its administrators. Mr. Pecksniff was perfectly correct when he declared that, while regaling on his humble fare and putting in motion the most beautiful machinery of digestion, he really felt at such times as if he was doing a public service.

In promoting the health and efficiency of our statesmen and politicians, it becomes increasingly urgent that the legislative chambers ought to be provided with what may be called comfort air conditioning equipment. The underlying requirements are knowledge concerning the human body and how it reacts to the environment. Most people give no consideration to the atmospheric conditions, and they unquestioningly accept them as the few necessary requirements of life. However, if we examine our intimate relation to the air, we realise its profound significance in our social and political life. Speaking generally, politicians during the Assembly sessions or during their tours in their constituencies may be regarded as imbibing from 40 to 50 pounds of air per day into their respiratory tract, consisting of the most delicate organs of the body. Viewed from this standpoint, the atmospheric surroundings, which we take so much for granted, become of great importance, and greater attention to factors affecting the purity and satisfactory condition of the air may be expected to result in a profound effect on the comfort, health and longevity of our politicians and statesmen.

If these desirable and necessary ends in the interests of public service have to be procured, it becomes imperative that the legislative chambers will have to be reconstructed according to the plan devised by the air conditioning engineer and the psychological architect. Air conditioning is really air sanitation and air hygiene in crowded rooms, and its purpose is directly to ensure comfort, by making the surrounding healthful, cheerful and pleasant. It is well known that politicians generally produce more heat than non-politicians, and their life depends upon the proper maintenance of the balance between heat production and heat dissipation. The air conditioning engineer therefore has to devote his energies to the factors on the heat loss side of the equation, while the nutrition expert will have to deal with heat production side, by prescribing suitable diet to the ministers and legislators. The responsibilities of the psychological architect are equally great. The shape and size of the building, the correct combination of colours both outside and inside, the surrounding gardens and illuminated fountains, and the prospect which the building commands are extremely important factors exercising profound influence in stimulating mental alertness, softening emotions and promoting cordiality of relationship, so essential for establishing co-operation between the Opposition and Treasury Benches. It has been ascertained that an average sized man 5 feet 9 inches in height and weighing 160 pounds might require 400 B.t.u. of heat per hour for a moderate temperature of 90°F. with moderate relative humidity and under moderate dialectical provocation. It is also known that an average adult person requires nearly 30 cubic feet of outside air per minute in the assembly chambers in order to keep the atmosphere free from odours. But the engineer and architect must have to make due allowance for provincial and individual variations.

Modern researches in psychology seem to establish the fact that the colour combinations of buildings, the colour and cut of clothes, the illumination of the rooms, the shape, size and material of furniture, apart

from the atmospheric conditions, exercise a profound influence on the temper and fitness of the legislators. It must be remembered that during prolonged discussions, they have to sit for hours together, and unless the seats are soft and adjustable to accommodate various physical postures, discomfort and proportionate inattention to discussion must inevitably result. In devising the construction of the building it is absolutely necessary to use materials for the construction of the walls, capable of absorbing all external noises, while preserving the acoustic conditions within unimpaired.

The electoral constituencies must recognise that the theory of human comfort and efficiency is based on regarding the human body as a heat engine, and that human life can exist through only a small range of body temperature centred round 98·6 degrees. If this physiological principle is firmly grasped, it may not be difficult for the electoral bodies to realise the fact that their representatives while discussing controversial measures like the Sarda Act and the Debts Relief Bill, are apt to generate heat equivalent to 2500 B.t.u. per hour and to perceive that, unless provision is made for its production and for its removal at the same rate for each degree of activity on the part of ministers and other legislators, the normal functions of the human organism are bound to become inefficient, and to that extent the interests of the country are bound to suffer. Both in self-interest and also for altruistic reasons, it is worth while for the country to recognise that the comfort and fitness of its administrators depend upon providing them with the highest and most artistic pleasures in human life. These pleasures, it must be pointed out, are due to causes which are essentially rhythmic. Coloured lights, painted and decorated walls, pleasing gardens, fountains, orchestra, optimum temperature, sweet odours and social teas must have a softening effect on frayed tempers, contributing towards mutual understanding and co-operation in the speedy despatch of State affairs. The electorates must consider the practicability and necessity of providing their representatives with these amenities which would make their life and work in the legislatures efficient, and which would establish communal peace and harmony, resulting in the welfare and prosperity of the country.

Planned Rural Reconstruction.*

THE Report of the Intergovernmental Conference of Far-Eastern Countries on Rural Hygiene is an impressive record. The agenda of the Conference embraced for consideration important problems such as health and medical services, rural reconstruction and collaboration of the population, sanitation and sanitary engineering, nutrition and measures for combating certain diseases in rural districts.

Governments have recently been realising in an increasing measure their obligations to the rural population and programmes working towards the improving of the social, economic, health and cultural conditions of the villagers are becoming more general and more comprehensive. This present Conference has brought together governmental representatives from the important countries of the East, who are in charge of a great variety of public services for rural uplift. Important decisions have been taken by the delegates and if they are implemented a great step will have been taken towards ameliorating the distressing conditions of the villagers. The discussions were particularly designed to show that the rural problems are of such a character that they demand the concerted planning and action of groups of technical persons, whose fields of activity have in the past been too frequently considered as separate and distinct. The opening of the public health work in rural areas can be used as the driving wedge for the development of a more comprehensive programme embracing education, economics, sociology, engineering and agriculture.

* Report of the Intergovernmental Conference of Far-Eastern Countries on Rural Hygiene, held at Bandoeng (Java), August 3rd to 13th, 1937, League of Nations, Health Organization, Geneva, 1937.

The Vitamin B_2 Complex and Allied Factors : Avian Factors.

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THERE is little need to emphasise the importance of studies in nutrition to the development of the poultry industry. Research of recent years has yielded results clearly indicating the disturbances in the well-being of birds concomitant with inadequacies of supplies of essential factors in the diet. This is particularly true of those factors which may be termed water-soluble and may be classified under the heading of the vitamin B complex. In a brief review of this nature only the most salient features of recent progress can be described. Any attempt to correlate the different factors required by birds and mammals such as the rat, dog, monkey or man is at present rendered difficult from the insufficiency of data.

The several factors postulated as necessary for avian nutrition may be summarised :

FACTORS OTHER THAN VITAMIN B_1 REQUIRED BY BIRDS.

Chick : Flavine
Anti-pellagra or filtrate factor
Vitamin B_4

Pigeon : Flavine.
Vitamin B_3
Vitamin B_5

Turkey : Flavine.

As well as these evidence for at least three other factors of fat-soluble nature has been presented : (1) Vitamin K, the anti-hæmorrhagic factor, (2) Anti-encephalomalacia factor of Goetsch and Pappenheimer and (3) a factor curative of erosions of the gizzard. At present there is very little evidence to show that these factors are needed by any other bird than the chick.

VITAMIN G (FLAVINE) AND THE FILTRATE FACTOR.

On synthetic diets and diets submitted to special treatment chicks develop a form of dermatitis described in detail by Ringrose, Norris and Heuser (1921)[1,2] as scaly incrustations of the mouth, eyes, legs and feet accompanied by a retardation in feather growth. Similar symptoms were observed by Kline, Keenan, Elvehjem and Hart[3] in chicks reared upon a diet of normal food-stuffs previously heated at 100° C. for 144 hours, a treatment which destroyed the preventive factor. The deficiency of the anti-dermatitis factor can be remedied by incorporating in the diet autoclaved yeast, skimmed milk, or liver extract. The latter is particularly efficacious in curing dermatitis and promoting growth in the chick and has served as a source of the factor in attempts on its isolation by Elvehjem and Koehn (1935).[4] A partial separation was effected by treatment of the liver extract with fuller's earth which, when removed by filtration, leaves the potent factor in the filtrate. These results have been confirmed by Lepkovsky and Jukes[5] who have designated the anti-dermatitis factor of the chick the 'filtrate factor'. For normal growth, however, another factor is required namely flavine which is removed from the liver extract by adsorption upon fuller's earth. Two factors at least are needed, therefore, in addition to vitamin B_1 by the chick (1) flavine also termed vitamin G and (2) the filtrate factor also called vitamin B_2. It should be noted that no definite nomenclature has yet been adopted for these factors ; different groups of workers employ various terms for the same factors.

Examination of the filtrate factor[6] has shown it to be a relatively inert substance untouched by oxidising and reducing agents but partially destroyed by warming with alkali. It is readily extracted from food-stuffs by hot or cold acidified water, not precipitated by phosphotungstic acid, untouched by benzoyl chloride, and not readily taken up by adsorbents. Its solubility in butyl and *iso*-amyl alcohol has provided a means for its purification.

There has been gradually accumulating evidence that concentrates of the filtrate factor, so potent in curing chick dermatitis, are also active in alleviating pellagra-like symptoms in other animals. Blacktongue in dogs[7,8,9] and pellagra in humans[10] respond to treatment with extracts of the filtrate factor from different sources such as rice, bran and liver. But it is still undecided whether the curative action of the extracts is to be attributed to the presence of one or more factors. There is the possibility that more than one factor is involved for Jukes[6]

has found that the distribution of the P–P factor and that of the filtrate factor in different food-stuffs do not run parallel.

The physical and chemical properties of flavine are too well known to necessitate recapitulation. Its exact function in chick metabolism is obscure although it is probably related to the oxidative metabolism of the tissues. No severe symptoms develop from a deficiency of flavine in the diet of the chick; growth is retarded and there is a tendency to diarrhœa which responds readily to flavine treatment.[11,12] Some claims have been made for its efficacy in curing leg weakness in the chick and in increasing the hatchability of eggs.[13,14] Its chief effect on the chick is growth promoting. A strange contrast to the chick is the case of the turkey. This bird on certain diets develops symptoms of dermatitis which can be cured by the administration of flavine.[11]

The symptoms of dermatitis developed in chicks on a heated ration of normal foodstuffs resemble closely those produced by feeding diets rich in egg-white. Lease and Parsons[15,16] have shown that thoroughly extracted liver residue alleviated the condition while liver extract rich in vitamin B_2 complex had no effect. Similar results were obtained by Tully and Franke (1934)[17] who considered that the effects of egg-white are due to a toxic agent which cannot be counteracted by vitamin B_2. It has, therefore, been concluded that dermatitis due to excessive amounts of egg-white originates from some other cause than a deficiency of the vitamin B_2 complex. This agrees with the work of György[18] who finds that the factor curative of the egg-white syndrone, termed by him vitamin H, is rendered water-soluble after enzymic hydrolysis of food-stuffs.

Other Chick Factors.

The need of the chick for flavine and the filtrate factor is definitely established. While the need of other factors is not to be doubted, further investigation is necessary to elucidate their functions and properties and to distinguish them from the known vitamins. The difficulty of rearing chicks on a synthetic diet, so frequently encountered,[19,20,21] was attributed to a deficiency of a number of factors resulting in multiple lesions. This was first indicated by the work of Hogan[22] and Boucher who found that chicks on a synthetic diet supplemented with the fat-soluble vitamins and vitamins B_1 and B_2 exhibit subnormal growth, paralysis, 'brain degeneration'; these conditions could be alleviated by the administration of hydrolysed yeast, ether extracted egg yolk, liver extracts and tiki-tiki, each of these materials presumably supplying a missing factor. The paralysis observed by Hogan and Boucher is not confined to chicks on synthetic and experimentally designed diets but is frequently seen in birds on practically normal diets (*e.g.*, range paralysis). The paralytic symptoms and the subnormal growth of such affected birds have been attributed by Elvehjem and his colleagues[23,24] to deficiencies in the diet of two factors present in liver. The anti-paralytic factor is considered to be vitamin B_4 since it was found that concentrates from hogs' liver or kentucky grass prepared similarly to the method of Kinnersley *et al.*,[25] for vitamin B_4 concentrates were active in curing paralysis and 'brain degeneration' but did not alone produce a maximum response in growth. Normal growth was attained when the vitamin B_4 concentrates and the liver residue were administered simultaneously. In more recent investigations, Kline *et al.*,[26] have discovered that the factor present in the liver residue is arginine, a fact of some interest since the basal diet appeared to contain adequate amounts of this amino-acid.

Microscopical examination of the brains of chicks suffering from paralysis revealed lesions, designated by Elvehjem and colleagues as 'brain degeneration'. Localised in the cerebrum and sometimes in the cerebellum, the affected areas were white and caseous and the cells œdematous. The similarity of this condition to that observed by Goetsch and Pappenheimer[27,28] in paralytic chicks led them to consider that they were dealing with a deficiency of the same factor, the encephalomalacia factor. The factor of Goetsch and Pappenheimer is, however, fat-soluble; it is present in vegetable oils, such as those of cotton seed and soya-bean. Saponification of the soya-bean oil with the exculsion of air leaves the factor in the non-saponifiable fraction. The fact that 'vitamin B_4' may be present in oils and the close resemblance of the symptoms observed by the two groups of workers suggests that only one factor may be involved. Elvehjem and his colleagues[29] claim to have differentiated the symptoms due to deficiencies of the two factors.

The use of different basal diets, generally designed to produce a deficiency of one particular factor and particularly of synthetic diets has yielded results suggesting that the chick requires for its normal development a number of water and fat-soluble factors. The failure to appreciate the necessity of the latter substances may have obscured the true response of the chick to the lack of the water-soluble factors. Substantial evidence has been presented for the existence of two fat-soluble factors other than vitamins A and D and the encephalomalacia factor namely, the anti-hæmorrhagic factor[30–35] or vitamin K and a factor protective against gizzard erosion.[6,36,38] A deficiency of vitamin K manifests itself by a delayed clotting time of the blood, a fact which has been utilised in devising a method for the assay of the vitamin. This factor is stated to be a complex hydrocarbon of molecular weight about 600, stable to heat and light and present in liver fat, hempseed, alfalfa grass, etc. A condition frequently developing concurrently with the symptoms of vitamin K deficiency is a disorder of the gizzard characterised by erosion and necrosis. The preventive factor is present in kale, alfalfa, wheat, bran, lung tissue, etc. Some confusion exists as to the exact nature of its properties and effects. The work of Almquist and Skotstad[37] appears to show that the factor is present in the saponifiable fraction of oils from greens; on the other hand, Kline *et al.*[38] state that it is insoluble in water, alcohol and ether. These discrepancies await elucidation.

Pigeon Factors.

Of the factors of the vitamin B complex evidence has been presented indicating that the adult pigeon requires at least three others in addition to vitamin B_1. The fact that pigeons on a polished rice diet supplemented by a vitamin B_1 preparation failed to attain their maximum weight led Williams and Waterman (1928)[39] to conclude that another factor, vitamin B_2, was necessary. This has been amply confirmed.[40, 41, 42, 43] O'Brien (1934)[44] found that full weight restoration could be obtained in the pigeon by the addition of a hydrolysate of wheat germ to the above diet supplemented by Peters concentrate (containing vitamins B_1 and B_5). A peculiar property of such vitamin B_2 extracts was their extreme sensitivity to oxidation. A more detailed investigation of the vitamin requirements of pigeons by Carter and O'Brien (1934, 1935, 1936)[45, 46, 47] has revealed that the problem was complicated by the inadequacy of the amount of protein in the diet and the period of preliminary depletion to which the birds were submitted to decrease their reserves of vitamins. A partial recovery in weight occurred in pigeons on polished rice and Peters concentrate receiving extra protein in the form of casein to correct the low protein content of the rice. But the extent of the restoration in weight was dependent upon the intensity of the initial depletion. Whereas most birds of short depletion recovered their maximum weight, a large percentage of the birds of long depletion failed to do so unless supplied with an alcoholic extract of liver. Treatment of this extract with fuller's earth yielded two fractions: one of high flavine content adsorbed on the fuller's earth and a filtrate carrying the vitamin B_2 activity. When supplementing one another the two fractions produced restoration to maximum weight. The flavine fraction was further purified on the lines usually adopted for the isolation of flavine. These results suggest that the pigeon requires flavine and vitamin B_2 in addition to vitamins B_1 and B_5. Further confirmation of the need of factors other than vitamin B_1 by the pigeon is found in the work of Ammerman and Waterman (1935).[48] A failure to regain their maximum weight was observed in pigeons on a diet of autoclaved whole wheat supplemented by doses of crystalline vitamin B_1 up to 180γ/day. This result has recently been confirmed by us.[49]

In 1930 Carter, Kinnersley and Peters[50, 51] submitted evidence for the existence of a factor distinct from vitamin B_2. Their experiments indicated that certain highly purified concentrates of vitamin B_1, administered in large doses, could not maintain the weight of pigeons. This was attributed to the lack of a factor which was found to be present in Peters concentrate, an alcoholic extract of norite charcoal obtained in the isolation of vitamin B_1 from yeast. The factor was termed vitamin B_5 and is present in yeast, marmite and whole wheat.

Heart Block in Pigeons.

Pigeons on a rice or synthetic diet are, as shown by Carter,[45, 52, 53] subject to

bradycardia and heart block. The condition manifests itself earlier than polyneuritis and is abolished by vagal section and atropine. It can be cured by the administration of yeast or substitution of a whole wheat diet from which it may be concluded that it is of dietary origin. It should be noted that rats on vitamin B_1 deficient diets develop a bradycardia without bundle block. But in contrast to the pigeon they are cured by the administration of vitamin B_1 (Drury, Maudesley and Harris, 1930[54]).

A discussion of the possible relation of avian factors to those required by man and animals would be premature. Nevertheless it is of interest to note that some of the water-soluble factors are needed by more than one species. Flavine for instance promotes growth of the rat, chick and pigeon and is curative of dermatitis in the turkey. The filtrate factor concentrates have been shown to be active in curing not only dermatitis in the chick but also black-tongue in the dog and pellagra in humans. More recently Lepkovsky and his colleagues[55] have found that concentrates of the filtrate factor promote growth in rats when supplemented by anti-dermatitis factor, vitamin B_6. It should also be noted that the liver concentrate containing vitamin B_2[47] is also active in stimulating growth in the rat in conjunction with the anti-dermatitis factor.[56] Whether these effects are due to the action of one factor is, at present, undecided.

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On the Origin of the Great River-Gorges of the Himalayas, as Evidenced by the Distribution of Fishes.*

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IT is a general feature of the mountain ranges of Asia that they are cut across by rivers which form stupendous gorges. Geographers and Geologists have suggested many explanations of the origin of the great river-gorges, but no one explanation has yet been accepted by all. It is, however, generally recognised that the gorges have been slowly carved by the rivers themselves during the course of ages. Some of the views regarding the origin of the Himalayan gorges are thus summarised by Burrard, Hayden and Heron (1933, p. 261):

"A gorge may be carved by water across a range in many different ways. Firstly, as a newborn range is rising slowly out of the ocean, it may be cut across at intervals by the sea and divided into a series of islands; the channels cut thus in early times may subsequently develop into river-gorges. Secondly, the snow and rain falling on the front slopes of a range may create glaciers and rivers, which slowly cut back by head-erosion and eat through the mountains. Thirdly, the snow and ice accumulating on the crest may gravitate towards the lowest points of the range, and thence flow off in opposite directions and wear away the rock on both flanks simultaneously. Fourthly, a river may be antecedent or older than the mountains, and have maintained its path across the latter as they rose. Fifthly, the flow of a river may be dammed by the rise of mountains across its path, and the waters of the lake so formed may eventually overflow and carve a gorge across the barrier range."

According to the latest paper on the subject by Wager (1937), there are only two alternative theories which are being discussed at the present day to account for the existing drainage pattern of the Himalayas. He states:

"One of the theories postulates that at an early age the Himalaya had ordinary consequent drainage, the rivers flowing north and south from the crest. This simple drainage pattern is considered to have been modified to its present form by some of the south-flowing rivers cutting back through the range and capturing rivers on the Tibetan side. The much greater precipitation on the south side of the range and the much steeper fall and therefore greater erosive power are put forward as possible reasons for the unusual behaviour of the south-flowing rivers. The alternative theory postulates that the Arun and similar rivers always had their present courses which, when they were inaugurated, were the easiest routes down an irregular surface sloping towards the Gangetic plain. Subsequently the Himalayan range is considered to have arisen up across the rivers, but so slowly that by vigorous erosion they were able to keep open their original channels."

The distribution of Himalayan fishes, both on the Tibetan and the Indian sides, sheds considerable light on this controversial problem. Day (1878), Stewart (1909) and the writer (1937) have shown from a comparison of the fish-faunas of the northern and southern faces of the great Himalayan range that the two faunas are very distinct. The writer has also indicated the probable origin of these faunas and concluded that though the Central Asiatic and the Indian faunas are derived from the same source, somewhere in Southern China, possibly Yunnan, the former became differentiated at a somewhat earlier age when the parent stock was of a generalised nature, whereas the fauna of the southren face appears to have been derived from a younger and more vigorous stock which had already become specialised in south-eastern Asia for life in torrential streams. At any rate, there is no indication that the two faunas had a chance to intermingle since their origin and the reason for their isolation is to be looked for in the origin and the present form of the Himalayas.

It is generally recognised that the whole length of the great Himalayan range is of one geological age. There are indications, however, that the Punjab Himalayas arose at a somewhat later date than the other three portions of the range, *viz.*, Assam Himalayas, Nepal Himalayas and Kumaon Himalayas. This would indicate that when the present-day fresh-water fish-fauna migrated from Southern China to India probably in the post-Eocene period, a barrier had already been created between the forms that spread toward north-west and those that spread toward south-west. The distribution of fishes shows that the drainage of the

* Read in the Geography Section of the Jubilee Session of the Indian Science Congress Association held at Calcutta, and published with permission of the Director, Zoological Survey of India.

Himalayas in the earlier stages was from east to west along both the faces. In the north the Tsangpo probably flowed into the present-day head-waters of the Indus and the combined river thus formed probably drained north-westwards into the Oxus; while in the south the Tertiary "Indobrahm" of Pilgrim (1919) and Pascoe (1919) had a similar course and drained into the Arabian Sea.

It seems that in the beginning the rise of the Himalayan foot-hills was probably of a more or less uniform nature, which permitted the formation of long longitudinal valleys in the foredeeps of the rising range; but later orogenic movements were certainly more marked in some portions of the range than in the others. These differential movements caused the dismemberment of the primary simple drainage pattern, the streams on the northern and the southern faces draining into their respective longitudinal basins. I have indicated in another place (1937*a*) how the distribution of fishes shows the evolution of the present-day sharp hydrographical divisions of the southern face of the Himalayas. A continuous stream of migration of forms like *Garra* Hamilton, *Glyptothorax* Blyth, *Amblyceps* Blyth, *Nangra* Day, etc., was checked by a sharp rise of the sub-Himalayas in the region of the principal peaks of the range near the border of the Assam and the Nepal Himalayas and diverted along the Satpura trend to the Western Ghats and thence to the hills of the Peninsula. Such a route of migration could only explain the occurrence of *Bhavania* Hora (Family : Homalopteridæ), *Parapsilorhynchus* Hora (Family : Cyprinidæ), *Silurus* Linn. (Family : Siluridæ), etc., in the extreme south of India on the one hand and of their close allies, such as *Balitora* Gray (Family : Homalopteridæ), *Psilorhynchus* McClelland (Family : Psilorhynchidæ), *Parasilurus* Bleeker (Family : Siluridæ), etc., in Eastern Himalayas and South-eastrn Asia on the other. In this case we have a clear proof of the sharp rise of the Himalayas not only in the cluster of high peaks found in this region, but in the barrier that was created against the migration of fishes to the western portions of the range and the dismemberment of the mighty river into the Brahmaputra Drainage System and the combined Indo-Gangetic System. Another differential earth movement, probably of a much later date, which elevated the Putwar basin into a plateau (Wadia, 1932) led to the further dismemberment of the "Indobrahm" into the Indus and the Ganges Systems of the present-day drainage pattern of the Himalayas. This division is reflected in the distribution of such genera as *Semiplotus* McClelland, *Chaca* Gray and *Erethistes* Müll. and Trosch., which are common to the Assam Himalayas and the Nepal Himalayas but are absent from the Punjab Himalayas. It is thus seen how a continuous westerly flowing river at the foot of the young Himalayas became dismembered into three drainage systems through sharp, localised orogenic movements. These movements also seem to have affected the drainage on the northern face of the Himalayas and established an easterly-flowing Tsangpo and the westerly-flowing Indus. Some of the changes in the drainage pattern of the Central Asiatic tributaries of the Indus studied by de Terra (1934) may have been contemporaneous with the rise of the Putwar basin or of that of the Pir Panjal.

From the above the following conclusions may be drawn with regard to the evolution of the present-day drainage pattern of the Himalayas, and consequently of the origin of the great river-gorges.

The distinctness of the northern and the southern fish-faunas of the Himalayas definitely favours the view that at an early age the Himalayas had ordinary consequent drainage, the rivers flowing north and south from the crest. Had the Himalayan range risen up across the river so slowly as to enable the rivers to keep open their channels by vigorous erosion there should have been very little difference between the fish-faunas of the *Cis-* and *Trans-*Himalayan portions of such rivers as the Brahmaputra, the Arun, the Sutlej, the Indus, etc. There is every reason to believe, on the other hand, that the rise of the Himalayas was in sharp, sometimes localised, orogenic movements so that the fishes of the southern face of the range were unable to adapt themselves to very turbulent waters and have, even to this day, remained confined along the southern face of the range to low valleys and are rarely found above an elevation of four to five thousand feet.

In this connection it may also be remembered that the so-called Indian monsoon conditions—south-west for four months and

north-east for three or four months—had begun before the Himalayas started to rise, as in the late Cretaceous period open seas of great extent existed to the south of India and some land had been formed to the north. The rise of the Himalayas had a great influence on the distribution of rainfall, for most of the moisture is now precipitated on its southern face; and there is practically no rainfall on the northern face of the Himalayas. Consequently, the rivers along the southern face are very turbulent while those on the northern face are placid, broad-valleyed and deep. Very different sets of ecological conditions were thus produced on the northern and southern faces of the Himalayas and these became accentuated as the mountains rose higher and higher.

When the south-flowing rivers, mainly through their erosive actions, captured the rivers on the Tibetan side it was natural that some of the fishes on the Tibetan side should have been washed down on the southern side, but they had to pass through such precipitous channels before reaching congenial conditions that with the exception of one genus of the Schizothoracinæ—*Oreinus*, a specialised member of the subfamily fully adapted for life in rapid mountain streams—no other member of the Central Asiatic fauna has been able to colonise the southern slopes of the Himalayas.

The migration of torrential fishes along the southern face of the Himalayas and from the Eastern Himalayas to the Hills of the Peninsula shows that the process of river-capture or river-deflection was a fairly common phenomenon in this territory and also in the region of the contiguous hill-ranges to the east. The distribution of specialised hill-stream fishes strongly suggests that in South-eastern Asia, as a rule, the rivers on the west beheaded the rivers on the east (Gregory, 1925) and thus effected the transference of the fish-fauna from the east to the west.

Summary.

A summary of the views regarding the origin of the great river-gorges of the Himalayas is given. It is pointed out that the fish-faunas on the northern and the southern slopes of the Himalayas are quite distinct, and that an explanation of this fact is to be found in the origin and the present form of the Himalayas. The evolution of the present-day drainage pattern of the southern face of the Himalayas is traced from the evidence afforded by the distribution of fishes and it is concluded that the early drainage of the Himalayas was from east to west along both the faces, and that it underwent considerable changes due to differential orogenic movements in the region west of the Tista drainage system and of the Putwar Plateau. The distinctness of the northern and the southern fish-faunas of the Himalayas favours the view that at an early age the Himalayas had ordinary consequent drainage, the rivers flowing north and south of the crest. The distribution of fishes along the southern face indicates that the rise of the Himalayas occurred in sharp, sometimes localised, earth-movements so that the fishes always remained in the valleys and were unable to colonise the precipitous higher reaches. A reference is also made to the influence of the monsoons on the southern face, and to the process of river-captures that probably played a great part in the distribution of fishes from the east to the west.

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The Relation of Zoology to Medicine, Veterinary Science and Agriculture.*

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FOR the study of the Animal Kingdom as a living unit, pure zoological studies, in which various animal types are taken in sequence and studied more or less separately with a view to getting some knowledge of the intricacies of the Animal World, have to be supplemented with a knowledge of the biological and ecological factors. Earlier trend in regard to zoological studies consisted, in the main, in detailed investigations of animals from the point of view of their anatomy, morphology and histology, their relationships with one another, their geographical distribution, their systematics, and, to a limited extent, their ecological relationships with one another, man and the Plant Kingdom. At the present day, however, much greater attention is being paid to the elucidation of biological and ecological factors, which often includes a great deal of experimental work. For all such studies, however, the work of the systematist is of prime importance. The very large number of species of the different classes of animals necessitates a careful survey and acquaintance with the different species. The vast nature of this problem can be roughly gauged from the tentative numbers of animal species which Clark estimates as follows: "The mere recitation of the names of the insects already known to us at the rate of four a minute for eight hours every day would require about ten months, and nearly three months additional would be required to name the remaining forms of animal life." The name of an animal, however, is nothing more than a key to its position in the Animal Kingdom and its probable relationships, with a possible clue to where in literature one should look for further information in regard to the particular species of animal under consideration.

Compared with most living creatures, man is relatively a new-comer on the face of the earth, for, even according to the most liberal estimates, primitive man did not appear till about a million years ago. All the same, man's interrelationships with the plant and the animal world are extraordinarily numerous and intricate. In the earlier stages of man's existence his relations with, at least, the larger animals were those of direct competition in a very keen struggle for existence. The animals supplied the major part of his food, his primitive clothing and other products for his very simple life. Later, however, when man assumed a greater mastery over the surroundings in which he lived, he, in addition to agriculture, took to domesticating certain classes of animals for making them his helpmates and companions. Several of them, such as the cattle and the horse, not only proved invaluable in connection with the advance of civilization, but made it possible for man gradually to occupy the proud position which he holds on the face of the earth to-day. Agriculture, which formed one of the main foundation-stones of his social edifice, was rendered possible by the domestic cattle, and even such insignificant animals as the earthworm and several classes of insects, birds, etc., are of infinite importance in this connection.

It is not possible to discuss here in any detail the importance of various classes of animals to one another, to man, and the plant life in general, but detailed biological and ecological studies carried out all over the world during the past 50 years or so have clearly demonstrated the great interdependence of plants and animals on one another, and how a large number of animals influence domestic animals, food-crops, fruit trees, etc., which are so essential for the existence of human life on the face of the earth. Details of some of these at least will be discussed by agriculturists, entomologists, medical men and others who have made a special study of these problems,

* Opening remarks in a discussion of the Sections of Zoology, Medical Research, Veterinary Research, Entomology and Agriculture in the Silver Jubilee Session of the Indian Science Congress Association, Calcutta, 1938.

and I, therefore, propose only to touch on a few of the general problems in this connection.

These general problems of the relationships of Zoology to Medicine, Veterinary Science and Agriculture, to which our discussion to-day is limited, are more or less similar and it is not necessary, therefore, to deal with them separately. The great achievements of Chemistry and Physics in the service of mankind and therefore, in reference to the advancement of civilization are well known to you all, but few of us recognise how even the somewhat superficial knowledge of the intricate laws of biology has helped in ameliorating the struggle of existence for man by providing increased supplies of food materials, by combating several dread diseases and thus making it possible for man and his domestic animals to lead longer and healthier lives, and finally by its valuable contributions to human culture and philosophy.

In a report on Economic Zoology, the late Sir Ray Lankaster divided animals in relation to man into 8 groups: 1. Edible animals, 2. Animal products, 3. Domesticated animals, 4. Animals which help in man's operations, 5. Direct enemies of mankind, 6. Indirectly injurious animals, 7. Animals that destroy man's property and stores, and 8. Man's indirect friends. Important as the edible animals and various animal products are, we need not consider them here to-day. Domesticated animals, animals which are of help to man directly or indirectly, and his indirect friends are useful to man in connection with agriculture, animal husbandry, etc., while the importance of a detailed knowledge of the direct enemies of mankind and domestic animals, the indirectly injurious animals and those that destroy man's property and stores to the allied branches of Medicine, Veterinary Science and Agriculture is incalculable.

Among the direct enemies of mankind and domestic animals, those of special importance in connection with Medicine, Veterinary Science and Agriculture are the parasites which are bionomically classed as temporary, permanent, facultative and obligate parasites or, according to their position in reference to the host, as external and internal parasites. According to Eccles, the number of such parasites is "more than half of all the animal creation". According to his studies of germ diseases, almost all animals harbour a great number of parasites and these, in turn, are themselves infected by other parasites. This condition is well expressed by the quatrain:

> "The little fleas which us do tease
> Have other fleas to bite 'em,
> And these in turn have other fleas,
> And so—*ad infinitum*."

All of us feel very proud of the achievements of Medicine in combating several very dreadful diseases of both man and animals, but it is seldom realized that in all such work the rôle of Zoology has been of paramount importance. Even as late as 1879 when Manson by his brilliant discoveries again brought to the forefront for medical research workers the part played by various animal parasites and carriers of diseases, such animals were regarded merely "with dislike or disgust, as irritating pests or as loathsome parasites". Since this date, however, their influence in the domains of human and animal pathology as the causative agents of several diseases, as carriers and agencies for spreading infections and as aggressively or defensively harmful animals has begun to be fully recognised.

Animal parasites of importance in connection with Medicine, Veterinary Science and Agriculture may, according to the class they belong to, be considered under the headings, (1) Protozoa, (2) Helminths, and (3) Arthropods.

Protozoa.—Though the number of Protozoa which are harmful to their hosts is comparatively small, they are responsible for some very serious and widespread diseases of both man and animals, such as Malaria, Kala-azar, Sleeping Sickness, Redwater Fever, East-coast Fever, etc., etc. Man and all domesticated animals are susceptible to infection by protozoan parasites, and with our increasing knowledge of the number of hosts and diversity of parasites with which each host may be infested, the subject has assumed a great deal of importance for both medical and veterinary research workers. The reason why these protozoal diseases are of greater importance in tropical countries like India is not because man and animals living

in such areas are themselves more susceptible to the effects of infection, but because of the greater possibilities of transmission of such diseases by the prepondering numbers of intermediate hosts or vectors, usually biting flies or ticks. The mode of transmission of such diseases is thus entirely different from that of direct contact infection as with most bacterial or virus diseases. Great advances have been made in India in regard to our knowledge of the life-histories and modes of transmission of several types of fevers, Kala-azar, Typhus, Sandfly Fever, Dengue, etc., of man and of Surra, Dourine, Bovine and Canine Piroplasmoses, Theileriasis, Anaplasmosis, Leishmaniasis, Spirochætosis, etc., of the different domestic animals. Our knowledge of the vectors of such diseases has also materially advanced, but a great deal still remains to be done and it is in this connection that a close co-operation of teams of research workers, including zoologists, medical men, veterinarians, botanists, biochemists, etc., is essential before the life-histories of the diseases can be fully elucidated and proper remedial measures effectively evolved and applied.

Helminths.—The parasitic worms responsible for the helminthic diseases of man and animals have assumed a much greater importance within the last quarter of a century or so. A great deal of systematic work has been carried out in this country on the different species of Nematodes, Cestodes and Trematodes, but our knowledge of the life-histori s and modes of transmission of a majority of these forms is still very meagre. With regard to the helminthic parasites of man, infection by which takes place through vectors, a great deal of work has been carried out in connection with Filariasis which is one of the most widespread human helminthic diseases in the country. Detailed biological work has shown that there are two types of infection of Filariasis in this country, one of *Wuchereria bancrofti* which is transmitted by the mosquito *Culex fatigans* and the other of *Filaria malayi* which is transmitted by mosquitoes of the genus *Mansonioides*. As the methods of control for the two species of mosquitoes responsible for the two types of infection are quite different, the biological methods of control for the two types of disease are, as has been shown by various workers, also necessarily different. The helminthic diseases of animals in the country are fairly numerous; of these, mention may be made of flukes of the genus *Schistosoma* which are responsible for a number of diseases of domestic animals, such as Bovine Nasal Granuloma, diseases due to *Schistosoma indicum* (Hepatic Cirrhosis of horses), *Bursati* (Harbronemic granuloma), Hump sore, etc., all of which are due to various helminthic parasites. A thorough knowledge of the life-histories of the parasites in all these cases is necessary for devising means to check these diseases, and in this connection collaboration between zoologists and veterinary specialists is absolutely essential. Reference may also be made here to the Eel-worm, *Tylenchus angustus*, which has been shown by Butler and others to be responsible for the serious disease *Ufra* of paddy in this country. This eel-worm is amazingly resistant, being able to live at least 8 months if fully dried and 2 months if fully immersed in water. This disease is responsible for a great deal of financial loss to agriculturists, and until the life-history of the causative agent is fully worked out, efficient methods for its control cannot be devised.

Anthropods.—The importance of several genera and species of Anthropods as vectors of various diseases of man, animals and in connection with agriculture need not be stressed upon. A great deal of work for the control of various diseases has been directed towards the elucidation of the life-histories of the various vectors and that part of the life-history of the pests which is passed in these vectors. In reference to human pathology, mention may be made of Malaria, Kala-azar and Bubonic Plague. With reference to Malaria, our information to-day is very extensive and studies based on a detailed knowledge of the life-history and distribution of the various species of *Anopheles* in the country have enabled the Public Health authorities to adopt measures for checking and ameliorating this disease. In regard to Kala-azar, the researches by the Kala-azar Commission and the authorities of the Calcutta School of Tropical Medicine have conclusively proved that the Sandfly, *P. argentipes*, is probably the sole transmitter of Kala-azar in India, but all attempts

to infect man artificially by infected flies have so far proved abortive. In regard to Plague, the importance of the fleas of the genus *Xenopsylla* as carriers of the disease from rat to man has been fully established and it has been found that *X. cheopis* has far greater plague-carrying powers than *X. astia* or *X. braziliensis*. A knowledge of the comparative prevalence of the different species of fleas of the genus in different areas would enable the Public Health authorities to gauge the exact situation in reference to this disease. For example, it has been found that absence of Plague in Madras City is due to the fact that the *astia* index in Madras is nearly 100 per cent, whereas in the infected areas in Bombay it is the *cheopis* index that is really high. All the same, our knowledge in reference to these forms is not quite complete, for Barraud found that both *X. cheopis* and *X. astia* are present in Assam, yet Assam has been remarkably free from Plague.

With regard to Veterinary Entomology a fair amount of work has been carried out in India, but a great deal still remains to be done and this is the reason why it has not been possible for the Veterinary authorities to evolve efficient measures for the control of various diseases of domestic animals for which Arthropods act as vectors.

The importance of insect pests to Agriculture will, I hope, be dealt with in detail by other speakers, and I need, therefore, only mention some of the more harmful species found in India: Locusts, various cotton pests such as the spotted bollworm, pink bollworm, cotton white fly, stem weevil, etc., borer parasites of sugarcane such as the top-shoot borer, stem-borer, root borer, etc., and a large number of pests of fruit trees such as the San Jose Scale, various genera and species of hoppers, etc. All these cause a great deal of damage to the different agricultural crops and fruit trees in the country.

Among the various methods of combating the parasitic and other harmful species of animals, the methods of biological control have of recent times assumed much greater importance than was hitherto assigned to them. As Sweetman, however, rightly points out, "While it is possible that one organism may not only control but eradicate another, our present knowledge of the fundamentals of biological control does not warrant undertaking eradication on a commercial scale by the biological method. This idea is worthy of consideration, however, and should not be excluded from our minds when carrying out experimental work." Further, since "the complex of environmental conditions responsible for the control of pests may vary in composition, both quantitatively and qualitatively, in different parts of the area inhabited by the species· · · ·the measures necessary to re-establish control in the case of an outbreak will vary also in different times and places." The method of biological control has many advantages but with our present knowledge it is not possible to apply it successfully against all pests.

In this short resumé I have only touched on the main problems which are of importance to man in his struggle for existence in connection with which the sister sciences of Medicine, Veterinary Research and Agriculture come into close contact with Zoology. The problems awaiting investigation in India are numerous, while the number of workers is unfortunately far from sufficient.

LETTERS TO THE EDITOR.

Absorption of Ultrasonic Waves by Organic Liquids.

Recent work on the absorption of ultrasonic waves by liquids carried out by Biquard, Claeys, Errera and Sack, Bazulin, Bar[1] and others, shows that in general, the absorption is higher than what the theory, according to Stokes, Kirchhoff and Rayleigh indicates. Various explanations have been offered to account for this absorption, chief among which are :—(1) that the medium is not perfectly homogeneous but consists of acoustically disordered medium, and (2) that the adiabatic compressibility depends on the frequency. It was thought necessary to extend the work further to seek correlation of observed data. The author has now carried out extensive work on 21 organic liquids comprising of hydrocarbons, alcohols, esters and halogen compounds between the frequency range of 3 mc. and 16 mc.

The method of measurement of sound intensities at various distances was to photograph the diffraction spectra produced by ultrasonic waves in liquids at different known depths (d) from the quartz disc and then to calculate the light intensities for the various orders from a previously determined density-log intensity curve for the 4358 ÅU. At 3 mc. and 7 mc., only the first two orders were photographed at different depths. By applying the Raman-Nath theory the various v values are determined, from which a, the absorption coefficient of sound intensity at those frequencies is calculated.

At 16 mc., only the first orders at various depths were photographed, giving the same time-exposure, and on plotting $\frac{1}{2} \log I_1$, against d where I_1 is the intensity of the first order and d has the same meaning as before, it was found that in all cases the graphs were linear. From these graphs the absorption co-efficient for sound intensity for each liquid was determined.

The frequency of oscillation N was determined in each case very accurately. These measurements on absorption were carried out at room temperature which ranged between 23° C. and 28° C.

The results are shown in Table I.

It is to be noticed that while generally the values for all liquids are high, those for benzene, chloroform, carbon tetrachloride, acetone and carbon disulphide stand quite outside the class of generality. Their values are distinctly very much higher, which cannot be attributed to any experimental error. This is so especially with CS_2, for which no diffraction spectrum of even a single order could be obtained at 16 mc.

The last column in the table gives the ratio γ from the available data. It is remarkable to note that the liquids for which the absorption is very high are just those which have a high value of γ. CS_2 has $\gamma = 1 \cdot 552$, while the sound absorption for

TABLE I.
(*Absorption of Ultrasonics by Liquids.*)

Liquids	$\frac{a}{N^2} \times 10^{17}$ at				$\gamma = \frac{\beta_T}{\beta_\phi} = \frac{C_p}{C_v}$
	3 mc.	7 mc.	16 mc.	Theoretical	
Benzene	367	441	925	17	1·379
Toluene	102	88	82	16	1·34
m-Xylene	116	102	94	16	1·292
o-Xylene	56	40	59	17·7	..
Tetralin	43	41	318	37	..
Hexane (*n*)	170	159	173	18·6	1·214
Heptane (*n*)	214	191	212	20·3	1·240
Methyl alcohol	631 (?)	68	57	28·9	1·174
Ethyl alcohol	173	75	72	44·6	1·214
Propyl alcohol	266	85	153	66·8	1·162
Amyl alcohol	339	171	249	127·9	1·323
Methyl acetate	221	49	200	8·76	1·205
Ethyl acetate	271	67	241	14·8	1·278
Propyl acetate	340	70	255	20·8	1·208
Amyl acetate	332	75	277	30·0	..
Ethyl formate	276	43	140	15·3	..
Chlorobenzene	271	133	189	17·4	1·397
Chloroform	545	431	565	21·4	1·499
Acetone	220	223	144	12	1·413
Carbon tetrachloride	421	492	632	40	1·392
Carbon disulphide	6150	7290	..	10·7	1·552

this liquid is the highest. A tentative suggestion is put forward that the value of γ is indicative of where exactly to expect the region of anomalous absorption.

The results of this investigation show that, just as in gases, we can also expect high absorption in liquids in regions where the contribution to specific heat due to atomic vibrations is nothing. However, Kneser's theory as applied to gases, requires modification for liquids, as the conditions are different in each case.

Further work in this direction is in progress.

A detailed paper will be communicated later.

S. PARTHASARATHY.
Indian Institute of Science,
Bangalore,
April 9, 1938.

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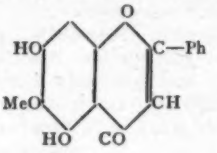
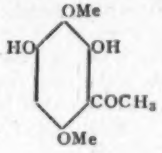
Synthesis of Wogonin.

THE authors have previously investigated the constitution of Oroxylin-A, a yellow colouring matter isolated from the root bark of *Oroxylum indicum* Vent., and arrived at 5 : 7-dihydroxy-6-methoxy flavone (I) structure as the most probable formula for Oroxylin-A.[1]

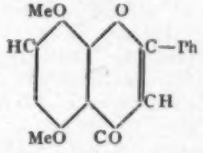
In attempts to synthesise (I) (*cf.* Wessely and Moser),[2] the authors condensed 2 : 4-dihydroxy-3 : 6-dimethoxyacetophenone[3] (II) with sodium benzoate and benzoic anhydride, obtaining 7-hydroxy-5 : 8-dimethoxyflavone (III). Demethylation of (III) with hot hydriodic acid led anomalously to 5 : 6 : 7-trihydroxyflavone (baicalein). Demethylation with anhydrous aluminium chloride (1·5 mols) afforded a trihydroxyflavone, m.p. 251–52°, which must be a dimorphic form of the known 5 : 7 : 8-trihydroxyflavone[4] (IV) for which the melting point recorded in literature is 227–28°.



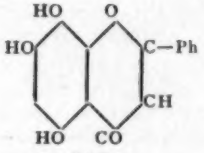
(I)



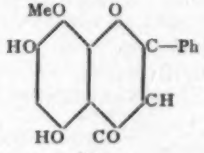
(II)



(III)



(IV)



(V)

Partial demethylation was achieved by the action of anhydrous aluminium chloride (0·75 mol) under milder conditions (*cf.* Gulati and Venkatraman),[5] and gave a dihydroxymethoxyflavone with melting point 200–201°, which is concluded to be Wogonin (5 : 7-dihydroxy-8-methoxyflavone) (V). Wogonin which has not been previously synthesised, was first isolated by Takahashi[6] from the root of *Scutellaria baicalensis* Georgi. Its constitution was investigated by Shibata, Iwata and Nakamura,[7] and subsequently more completely by S. Hattori,[4] who assigned to it the formula of 5 : 7-dihydroxy-8-methoxyflavone. The melting point and properties including colour reactions, solubility, etc., of our synthetic product agree in all respects with those recorded for Wogonin in literature.

The experimental work described in this note was carried out in the Pharmacological Laboratories of the Seth G. S. Medical College, Parel, Bombay.

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C. R. MEHTA.
T. S. WHEELER.

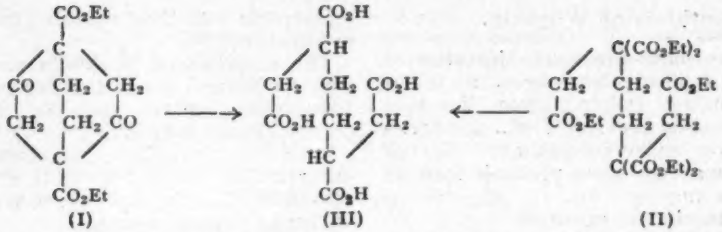
Ismail College, Andheri,
Seth G. S. Medical College, and
Royal Institute of Science,
Bombay,
April 11, 1938.

[1] *J.C.S.*, 1936, 591.
[2] *Monatsch.*, 1930, **56**, 97.
[3] Baker, Nodzu and Robinson, *J.C.S.*, 1929, 74.
[4] Hattori, *Acta Phytochim.*, 1930, **5**, 99.
[5] *J.C.S.*, 1936, 267.
[6] *Chem. Zentr.*, 1889, **2**, 100.
[7] *Acta Phytochim.*, 1923, **1**, 105.

Synthesis of ββ′-dicarboxy Suberic Acid.

IN a previous communication by one of us[1] it was shown that bi*cyclo*-(2 : 2 : 2)-octanedione dicarboxylic ester (I) gave on treatment with 10 per cent. alcoholic potash a compound which appeared from combustion analysis and equivalent determination to be ββ′-dicarboxy suberic acid. As this acid is not known in literature, it was considered desirable to synthesise a compound of this structure and then prove its identity with the acid obtained from (I) by alkali treatment.

Ethyl ββ′β′-tetracarbethoxy suberate (II) has been obtained (i) by the action of ethylene bromide upon carbethoxy succinate



(I) (III) (II)

and (ii) by the action of ethyl bromacetate upon ethyl butanetetracarboxylate. The hexa ester (II) on being boiled with hydrochloric acid (1 : 1) during 18 hours gets hydrolysed and decarboxylated to give rise to $\beta\beta'$-dicarboxy-suberic acid (III). (Found : C, 45·04 ; H, 4·52 ; Equiv., 66·34 ; Calc., C, 45·78 ; H, 5·38 per cent. ; Equiv., 65·5). The acid (III) melts at 177–78° when it is first crystallised from acetic acid and then from water. The acid (III) obtained from (I) on being crystallised from acetic acid and then from water also melts at 177–78° ; the mixed melting point with the synthetic variety (m.p. 177–78°) remaining undepressed. The ethyl ester of the acid (III) boils at 195–205°/2 mm. (Found : C, 57·91 ; Calc., C, 57·75 per cent.).

With a view to effecting a double Dieckmann condensation with the tetra ester, it has been subjected to the action of molecular sodium under varying experimental conditions, the results of which will shortly be published elsewhere.

P. C. GUHA.
C. KRISHNAMURTHY.

Department of Organic Chemistry,
Indian Institute of Science,
Bangalore,
March 25, 1938.

[1] Guha, *Curr. Sci.*, 1936, 5, 19.

The Colouring Matter of Deccan Hemp (*Hibiscus cannabinus*) Flowers—Cannabiscitrin and Cannabiscetin.

FROM the pale yellow flower petals a yellow crystalline glucoside having the formula $C_{21}H_{20}O_{12}$ has been obtained. It yields a colourless non-acetyl derivative on acetylation. On hydrolysis with dilute mineral acids, it produces a molecule of glucose and a flavonol having the composition $C_{15}H_{10}O_8$. The flavonol which occurs free also to some extent forms a hexa-acetate and a hexamethylether and displays bright colours in dilute alkaline solutions in the presence of air. It is a penta-hydroxy flavonol which is not identical with gossypetin, quercetagetin or myricetin, but is isomeric. This new member of the flavonol series is named Cannabiscetin and the glucoside therefore becomes Cannabiscitrin. From the flowers of *Hibiscus sabdariffa*, Perkin[1] isolated besides gossypetin a pigment of unknown constitution which he named Hibiscetin. Hence the new names given by us indicate origin from *Cannabinus*.

Cannabiscetin resembles gossypetin in giving the gossypetone reaction though not so readily and probably therefore contains two hydroxyl groups in the positions 5 and 8. Further work is in progress.

K. NEELAKANTAM.
T. R. SESHADRI.

Department of Chemistry,
Andhra University,
Waltair,
March 14, 1938.

[1] A. G. Perkin, *J.C.S.*, 1909, 1855.

Influence of Added Chemicals on the Destructive Distillation of Cocoanut Shells.

SUDBOROUGH, Watson and co-workers[1, 2] in an exhaustive study of distillation of different species of wood and wood wastes, found among the latter class, that cocoanut shells yielded the highest percentage of acetic acid in the pyroligneous liquor. They also found that the yield of the settled tar from the same source was sufficiently great to warrant a closer study with a view to obtain creosote therefrom. The distillation of the cocoanut shells has been carried out by A. H. Wells,[3] Georgi and Buckley[4] and by Kidavu and Nambiyar.[5]

It appears that Hawley[6] was the first to study the influence of added salts on the course of distillation and on the yield of products in wood, but several other workers have carried out similar studies elsewhere. The present study was undertaken with a view to follow the course of reaction as well as of the alteration in the yield of products, due to the impregnation of shells with various salts, and then subjecting them to destructive distillation. A study was also made of the variation in the yields from the shells of different localities.

Shells from Bangalore and Trivandrum were first crushed in a jaw crusher, and graded. This material was well mixed with solutions containing various percentages of salts, and evaporated and dried over a water-bath to its original weight. The material thus treated was distilled in one kilo lots in an electrically heated retort.

The temperature of the retort was gradually raised by passing the current intermittently, the maximum temperature recorded being 320° C. The total time for distillation was little over three hours, the time during which the current was passed being only about an hour and a quarter. Distillation starts after half an hour's heating, when a colourless distillate collects in the receiver. The rate of distillation increases gradually reaching the maximum, soon after the retort attains a temperature 280° C., when the current can be completely cut off for over half an hour. At this stage the evolution of gaseous products reaches the maximum; and the nature of the flame indicates the absence of unsaturated hydrocarbons, which however appear towards the end of the distillation.

The rate of distillation is hastened by salts like sodium carbonate and magnesium chloride, even at a lower temperature, while a salt like sodium phosphate has no such effect. Zinc and magnesium salts give an increased yield of pyroligneous liquor and reduce the yield of tar while aluminium salts reduce the yield of pyroligneous liquor but slightly increase the yield of settled tar.

Shells from different localities gave different yields of tar, and acetic acid in the pyroligneous liquor as shown in the following table.

Table showing the yield of products from treated and untreated shells and from different localities.

Products	Shells (untreated) from Bangalore percentage	Shells (untreated) from Trivandrum percentage	Shells (treated) from Trivandrum	
			Zinc salt	Aluminium salt
Charcoal ..	37·2	35·1	35·5	37·5
Pyroligneous liquor ..	39·4	41·0	43·5	38·3
Settled Tar ..	5·4	7·2	5·0	7·7
Gas (by difference) ..	18·0	16·7	16·0	16·5
Acetic acid in pyroligneous liquor ..	14·0	7·3	8·0	6·8

Further work with the different products and their economic utilization according to the present needs of the country is in progress.

This work was carried out in the laboratories of the General Chemistry Department of the Indian Institute of Science during the summer vacations of the past four years. My best thanks are due to Professor H. E. Watson and Dr. K. R. Krishnaswami for their kind interest and suggestions during the course of the work.

S. RAMACHANDRAN.
Department of General Chemistry,
Indian Institute of Science, Bangalore,
and St. Joseph's College,
Bangalore,
March 8, 1938.

1 "*Wood Distillation*," *J. Ind. Inst. Sci.*, 1918, **2**, VII, 285–89.
2 — *ibid.*, 1920, **3**, IX, 293–306.
3 *Philippine J. of Sci.*, 1917, **12**, (A), p. 111.
4 *Malay Agric. Jour.*, 1929, **17**, 398-402.
5 *Madras Agric. Dept. Year-Book*, 1927, 33–35.
6 *J. Ind. Eng. Chem.*, 1922, **16**, 43–44.

Photoelectric Saccharimeter—A New Physical Instrument for the Polarimetric Estimation of Cane-Sugar.

QUANTITATIVE estimations of cane-sugar through its action on plane-polarised light are carried out in specially designed polarimeters called saccharimeters. The method is capable of great accuracy and has the additional advantage of being quickly performed. The saccharimeters while convenient in many respects suffer from certain inherent defects. Limitations in the sensitivity of the human eye introduce errors in the matching of the two halves of a polariscope field. Loss of light in the solvent and on the sides of the observation tubes is not compensated.

To eliminate the personal error in observation inherent in the saccharimeters, Harton[1] has developed a photoelectric saccharimeter. The author has employed in practice one photocell and the bridge circuit, while also suggesting the use of two cells.

The present communication details a new photoelectric saccharimeter developed in these laboratories and in use for some time.

The principle in brief consists in interposing the test sugar solution and its solvent in the path of two equal beams of white light and compensating the change of light due to polarisation by movement of the quartz-wedge. Photoelectric cells are used to indicate equivalence of light.

A schematic section through the apparatus is given in Fig. 1.

The source of light L is a 30 watt 8 volt "Nitra" lamp supplying a very intense light which is regular and easily adjustable. The two equal beams of light from the lamp pass through the tubes A_1 and A_2 containing the polarising nicols p_1 and p_2. The polarised rays of light then impinge on the polarimeter tubes T_1 and T_2. The light from the latter then pass through the tubes B_1 and B_2 containing the double quartz-wedge compensating systems ($+_{J_1J_2} + _{L_1L_2} - _{M_1M_2} - _{N_1N_2}$) and the analysing nicols a_1 and a_2 and finally activate the photoelectric cells C_1 and C_2 respectively. The circuit is essentially of the bridge type similar to those used by the authors in their previous instruments (Singh and Rao[2,3]). R_1 and R_2 are the protective resistances of 10,000 ohms and G, a sensitive galvanometer. The differences, if any, in the two cells are eliminated by the use of the common battery and shunted by *r*. The double

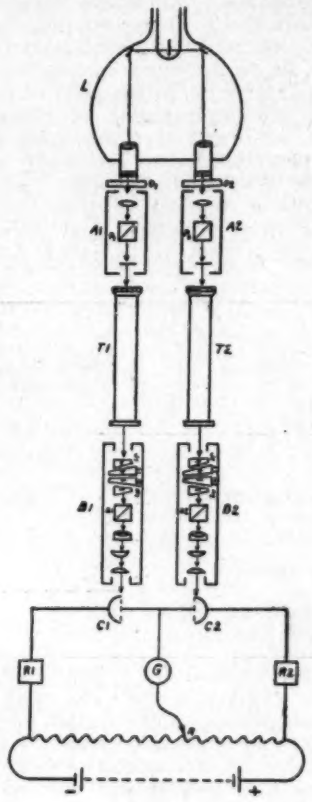


Fig. 1.

Schematic section through the photoelectric saccharimeter.

wedge compensator consists of two wedges of dextro-rotatory quartz ($+_{J_1} + _{L_1} + _{J_2L_2}$) and two wedges of levo-rotatory quartz ($-_{M_1} - _{N_1} - _{M_2N_2}$). One of the wedges of each system (L and M) is movable and provided with a scale (one on each side of the instrument) which can be read through the same telescope as in the Schmidt and Hænsch saccharimeter.

The light before entering the polarimeter tubes is filtered through the cells O_1 and O_2 containing potassium bichromate solution of such a concentration that the

product of the percentage concentration and the length of the column in centimetres is 90.

The use of the polarimeter tubes of the type of the U.S. Bureau of Standards[4] eliminates the annoyance of the air bubble by means of the cavity blown in the glass. As in all modern saccharimeters, the scale is graduated according to the decimal system and gives the percentage of sugar directly.

The operation of the instrument is easy. First, the instrument is adjusted for optical and electrical equality as indicated by the null-point.* The sugar solution to be estimated is filled into a polarimeter tube and brought into the path of one of the beams of light. A similar tube filled with distilled water is brought into the path of the other beam of light. This compensates the loss of light in the solvent and on the sides of the polarimeter tubes. Now the lights falling on the photocells are changed and consequently the bridge is thrown out of balance and is indicated by the deflection of the galvanometer. The change of light due to polarisation is then compensated by moving the appropriate quartz-wedge compensator on the side of the test solution† and the value noted on the corresponding scale. The polarimeter tubes and the contents are now interchanged and a second measurement taken. This eliminates the variations in the wall thickness, if any, of the polarimeter tubes and promotes greater accuracy.

The instrument offers over the existing ones the advantages of a combination of stability, sensitivity and simplicity.

B. N. Singh.
N. K. Anantha Rao.

Institute of Agricultural Research,
Benares Hindu University,
May 3, 1937.

* For obtaining this, r can be used as a fine adjustment.

[1] Horton, H., *Internat. Sug. J.*, 1935, **37**.

[2] Singh, B. N., and Anantha Rao, N. K., *Curr. Sci.*, 1937, **5**.

[3] — —, *Plant Physiol.* (in press).

[4] *Zeit. ver. Dent. Zuck.*, **54**, 521.

† The compensation can be effected from the side of the solvent also which allows the measurement being taken from both sides and checking the results.

Megasporogenesis and Female Gametophyte in *Malpighia punicifolia* Linn.

The Malpighiaceæ have attracted the attention of Morphologists as early as 1860, when Brown investigated Banisteria and Stigmatophyllum and reported polyembryony. Schurhoff[1] investigated two genera of *Malpighia* and *Bunchosia* and reported a sixteen nucleate embryo-sac which develops after the Lilium type and has four tetrads of nuclei in the four poles of the embroy-sac. Subba Rao[2] (1937) has investigated *Hiptage madablota* and finds a sixteen nucleate embryo-sac and polyembryony—the embryos apparently developing from the nucellus since no fertilization has been observed.

The present investigation is on *Malpighia punicifolia* and the salient observations are presented here.

The ovary is trilocular with one semi-anatropous ovule in each locule.

Unlike the two species of Malpighiaceæ investigated by Schurhoff (1924), *Malpighia punicifolia* shows a multicellular archesporium consisting of three or four cells, hypodermal in origin. They can be easily made out even before the integuments appear, by their large size and dense cytoplasm (Fig. 1).

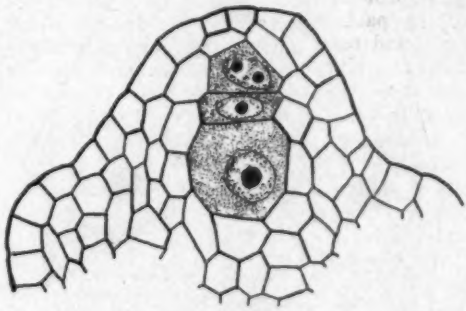


Fig. 1. × 800

The archesporial cells cut off parietal cells and later are found situated deep down in the nucellus. Fig. 2 shows four degenerating megaspore mother-cells and the functioning one with its nucleus undergoing meiotic changes. This shows that a single megaspore mother-cell develops into the mature embryo-sac.

The nucleus of the functioning megaspore mother cell undergoes meiotic changes and develops into a Lilium-type of embryo-sac

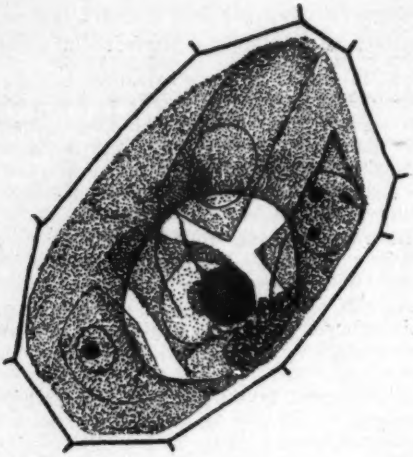


Fig. 2. × 800

without the intervention of a linear tetrad. The four nuclei are arranged crosswise with oblique spindle fibres interconnecting each nucleus (Fig. 3). By this time, the mature

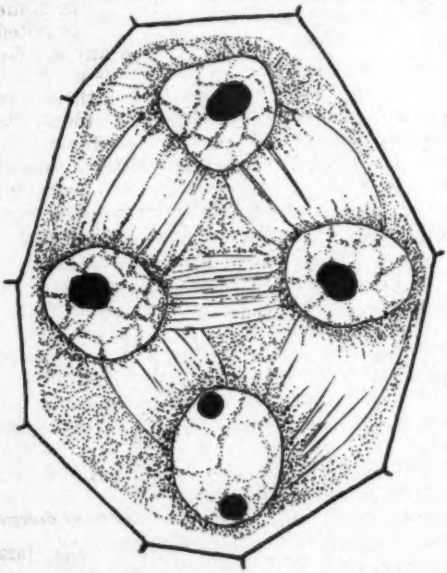


Fig. 3. × 400

embryo-sac has become long and barrel-shaped. Each of the four nuclei divides twice giving rise to four nuclei (Fig. 4). At the end of these divisions there are four groups of four nuclei giving a sixteen-nucleate embryo-sac. One nucleus from each of

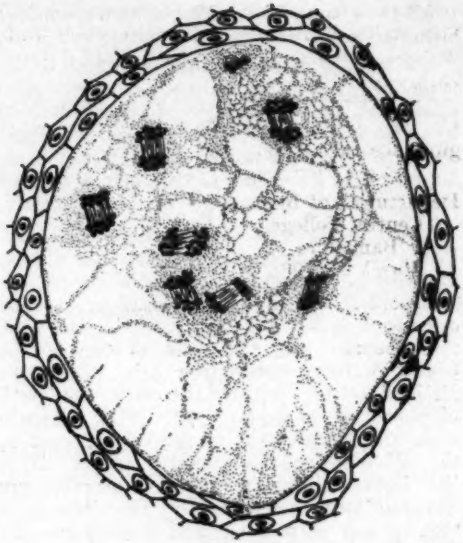


Fig. 4. × 280

these groups migrates to the centre to form a four nucleate-fusion nucleus. Now, four groups of three nuclei are found in the embryo-sac with the four-nucleate 'fusion nucleus' in the centre (Fig. 5). There is

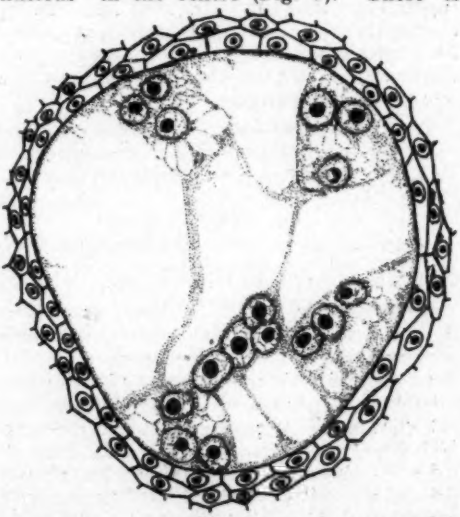


Fig. 5. × 280

no definite organisation of the nuclei into the egg and synergids in any of these four groups. Later stages in all the ovules show the degeneration of the four groups of nuclei.

All the genera of the Malpighiaceæ worked hitherto have shown polyembryony; but, *M. punicifolia* does not show any polyembryony.

The writer expresses his indebtedness to Dr. M. A. Sampathkumaran for his kind guidance throughout this work.

S. G. NARASIMHACHAR.

Department of Botany,
Central College,
Bangalore,
March 23, 1938.

[1] Schurhoff, *Die Zytologie der Blutenpflanzen*, Stutgart, 1926.

[2] Subba Rao, A. M., "A note on the development of the Female gametophytes of some Malpighiaceæ and Polyembryony in *Hiptage madablota*," *Curr. Sci.*, Dec. 1937.

Two Different Chromosome Complements found in *Gryllotalpa* (Orthoptera) from Ahmedabad, Western India.

THE genus *Gryllotalpa* has furnished very interesting material for chromosomal studies to several authors.[1] Taxonomically, it is rather intriguing, as compared with the existing variety of species or forms, about which systematists are often in doubt, the variations in respect of the chromosome complexes found in the forms collected in such diverse regions of the world as America, several localities in Europe and lately Japan and India are indeed striking. On reference to the literature cited below it will be found that chromosomal garnitures of forms so far investigated show remarkable variations not only in the number and size of the elements composing them but in the form and behaviour of their idiochromosomes also.

Some years ago the material on which the present observations are based was collected in the vicinity of the Gujarat College, Ahmedabad. Unfortunately, the individuals, nymphs and adults, from which the gonads were dissected out, were not kept separate. They were regarded as members of one and the same species, *Gryllotalpa africana*, Pal. B. following the observations made by Lefroy.[2] In this material two different chromosome complements are found. In the testes of some individuals 23 chromosomes are found to form the spermatogonial (2 N) set (Figs. 1 and 3). This chromosome complex has been so far seen only in the Japanese form of *Gryllotalpa africana*, Pal[1] (Ohmachi). The other garniture seen in our slides is

Fig. 1.

Fig. 2.

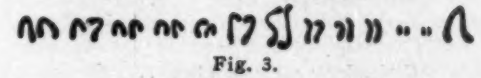


Fig. 3.

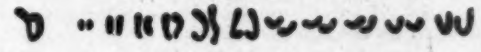


Fig. 4.

The spermatogonial complements of *Gryllolalpa*. (4000 ×)

composed of 25 elements, two more in number than that observed in the previous one (Figs. 2 and 4). These additional chromosomes are represented by the two smallest dot-like elements, shown by 'm' in Fig. 2, while the other elements between these two chromosome complements are quite similar as seen in Figs. 3 and 4. Such a chromosome complex consisting of 25 elements, as noted above, has never been known in any species of *Gryllotalpa* so far studied. It is a matter for further investigation whether these two different sets of chromosomes found in *Gryllotalpa* from this locality are due to the fact that they come from two different forms or species, or they have resulted from the occurrence of two supernumerary chromosomes as is generally found in Hemiptera.

J. J. ASANA.

Gujarat College,
Ahmedabad,
April 12, 1938.

[1] Rath, O. vom., *Arch. f. mikro. Anat.*, 1892, **40.**
—, *ibid.*, 1895, **46.**
Senna, *Mon. Zool. Ital.*, 1911, **22.**
Baumgartner, *Science*, 1912, **35.**
F. Payne, *Archiv. f. Zellf.*, 1912, **9.**
—, *Jour. of Morpho.*, 1916, **28,** No. 1.
D. Voinov, *Arch. Zool. Exp.*, 1914, T. **54.**
—, *ibid.*, 1925, T. **63.**
H. de Winiwarter, *Extrait des Archiv. de Biologie*, T. **37,** Fac. **4.**
F. Ohmachi, *Proc. of Imperial Acad., Tokyo.*, 1929, **5,** No. **8.**

[2] M. Lefroy, *Indian Insect Life*, 1909, W. Thacker & Co., 2, Creed Lane, London.

Chromosome Numbers in Some Economic Flowering Plants.

CHROMOSOME numbers in several species of economic plants have been determined

No.	Name of plant	2n number	Size of chromosomes	Remarks
1	*Arachis hypogœa*, Willd. ..	40	Normal	Sterile plant without normal flowers or fruits. Short internodes and close set leaves (*Proc. Ind. Acad. Sci.*, 1936, **3**, 218).
2	*Moringa oleifera*, Lamk. ..	28 *plus* 2 fragments	Small	The *n* number was previously reported by the authors to be 14 (*Curr. Sci.*, 1937, **5**, 479).
3	*Coriandrum sativum*, Linn. ..	22	Medium	Reported for the first time.
4	*Vetiveria zizanoides*, Nash ..	30	Medium	The numbers in other oil-yielding grasses of South India were reported by Babu (*Curr. Sci.*, 1936, **4**, 874).

in this laboratory. The table above gives the 2*n* number of some of the species.

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Coimbatore,
February 21, 1938.

An Attempt at Foreshadowing Monsoon Rainfall in Mysore.

IN Vol. XXIII, Part II of the *Memoirs of the Indian Meteorological Department* (1922), Sir Gilbert Walker has given a formula for foreshadowing the monsoon (June to September) rainfall of Mysore, which is as follows:—

Mysore rain = + ·16 (India pressure, May)
− ·26 (Zanzibar rain, May)
− ·38 (Java rain, October to February)

with a joint correlation coefficient, R = ·57.

In obtaining the above formula the rainfall of the whole State of Mysore was used for the years 1875 to 1919. Owing, however, to the paucity of raingauge stations in the earlier years, the rainfall of Mysore was based on the records of only eight district headquarters stations from 1875 to 1890; from 1891 however the records of 74 stations were utilised, and the number rose to 77 in 1896 and remained at that figure upto 1919.

It is well known, however, that the State could be divided into two district regions, the Malnad and the Maidan. The Malnad or the land of hills and rain, comprises the Western Ghats and the narrow belt of hilly country adjoining it along the western border of the State—a region of ever-green forests and torrential rainfall aggregating in places to over 300 inches in the year. The Maidan or the level country comprises most of the Mysore plateau, where the annual rainfall is in places 25 inches or less. Nearly 90 per cent. of the annual total is gauged in the monsoon months of June to September in the Malnad, but not more than 50 per cent. of the annual rainfall occurs in the Maidan region in this period. July is the wettest month in the year for the Malnad, while September is the wettest month for the Maidan region. Further, while a strong monsoon on the west coast is favourable for rain in the Malnad, it is during periods of weak monsoon, when the development of local convection is favoured, that good showers occur in the Maidan parts.

It was therefore considered desirable to treat the Malnad and Maidan regions separately in our investigations in deriving fresh foreshadowing formulæ for Mysore. Nine taluk stations in the Malnad with an average rainfall of 85 inches in the monsoon season, June to September, were selected to represent the Malnad. The other seventy taluk stations with a seasonal average of 13 inches represent the Maidan region. The rainfall data for the 43 years 1893 to 1935 were utilised.

The correlation coefficients of the monsoon rainfall of these two regions were worked out with the pressure, temperature or rainfall of many of the centres of action used by Sir Gilbert Walker in his latest paper

in the *Memoirs of the Indian Meteorological Department*, Vol. XXIV, Part X, for the contemporary quarter and the two preceding quarters. A selection was made from these coefficients, and after further analysis into months where necessary, the regression equations given below were derived.

Malnad.—The factors selected for Malnad in the order of their decreasing importance are (1) pressure over India in May, (2) South American pressure in April and May and (3) rainfall in Java from October to February. Factors (1) and (2) are favourable when in excess, but excess of rain in Java from October to February prejudicially affects the Malnad rain in the subsequent monsoon season. The regression equation formed is

Malnad rain = + ·22 (India pressure)
+ ·27 (South American pressure)
− ·26 (Java rain)

with a resulting joint correlation coefficient R = ·52.

The joint coefficient is small, but still the very bad years 1899, 1905 and 1918 are definitely indicated, while there is also a fair indication of the abnormally wet years 1896, 1900 and 1924.

Maidan.—The factors selected for the Maidan rainfall are in the order of their decreasing importance (1) Central Siberia pressure, March; (2) Honolulu pressure, March to May; (3) North-West India pressure, March to May; and (4) Mean pressure of Mauritius and Seychelles, March to May. Of these the first three are favourable when in excess and the last when in defect. With these the following regression equation was formed:

Maidan rain = + ·23 (Central Siberia pressure)
+ ·37 (Honolulu pressure)
+ ·25 (North-West India pressure)
− ·35 (Mauritius + Seychelles pressure)

with a resulting joint correlation coefficient R = ·66.

It was found, however, that Central Siberia pressure had comparatively high cross co-efficients with Honolulu and North-West India pressures; further its data were not available after 1932. Omitting this factor, the following regression equation was formed:

Maidan rain = + ·45 (Honolulu pressure)
+ ·30 (North-West India pressure)
− ·38 (Mauritius + Seychelles pressure)

with a resulting joint correlation coefficient R = ·63.

It can be seen that the omission of Central Siberia has not led to any appreciable decrease in the joint correlation coefficient.

Further investigations are in progress to improve the formulæ and to discover a foreshadowing formula for the Maidan rainfall during the months September to November, when nearly half of the annual rainfall is received. Rainfall during these months is very important from the agricultural point of view as the Mysore tanks generally get filled in this period.

We are thankful to the Director-General of Observatories for having kindly allowed us to use the data available in the India Meteorological Department.

C. Seshachar.
V. Doraiswamy Iyer.
Central Observatory,
Bangalore,
April 2, 1938.

The Mathematical Theory of a New Relativity.

Reply to Zahur Hussain's Criticisms.*

It is surprising that while picking out just a few isolated points, the critic should have claimed that "the whole theory (of mine) is examined, and is found to be, at least in its form, untenable". I am replying to the critic's four points, serially:—

1 and 2. These two paragraphs dealing with relative velocity, contained in Ch. V, Sec. II, are based on a misapprehension of my paper. I have maintained that there is one and only one correct way of calculating the absolute relative velocity, which however is not available to a human observer. This would be availed of only by a Superman, who is himself absolutely at rest and can measure absolute distances, absolute time and absolute velocities *instantaneously*, and not with the help of a messenger travelling with a finite velocity like that of light. Every other method of measuring relative velocities is inexact, as for a human observer

* *Cf. This Journal*, 1937, **6**, 291.

it is just as impossible to measure the absolute relative velocity as to measure the absolute distance or time. All human measurements, therefore, necessarily involve some wrong assumption, with the result that "the value of relative velocity will vary with the method employed to measure it". The formula given by me in Chapter V was one based on a professedly wrong assumption. Several other formulæ, equally based on other professedly wrong assumptions, were given by me in Chapter VII. These formulæ hold universally so long as the method is not changed. Had the critic objected to the use of the word "universal". I would have gladly agreed that it was unhappy. The critic has adopted another method, which I have not considered it worth while to check, as I am prepared to assume, consistently with my assertion, that it gives another result.

I emphasize that I have myself rejected these inexact formulæ and never utilised them in any subsequent chapter whatsoever; and in particular there is no reference at all to them in Chapter XIII, nor Chapter XIV, nor Chapter XV, which contain my Law of Gravitation in its final form, with its attendant predictions. It is therefore somewhat astonishing to read that "the formula is one of the corner-stones of the whole edifice". As a matter of fact, the exact Transformation Formulæ for light have been deduced by me in Chapter XV, Sec. VI.[1]

3. The critic's main objection to Chapter VIII is that "a most interesting point has been overlooked that as gravitation is supposed to travel with the huge velocity D it has long ago spread all over the solar system, and the planets are simply passing through a sort of static field". Such a view would have been plausible if the heavenly bodies were all stationary. But the gravitating sources themselves are in motion. Any advanced book on electricity would show that in such a case the principle of "retarded potential" would be applicable if the velocity of gravitational propagation be finite.

4. My treatment in Chapter XIII has been entirely misunderstood by the critic. His agrument that when $A \times B = C \times D$ then $(A + L)B = (C + \gamma)D$ only when $\gamma = L\frac{B}{D}$ is based on an erroneous impression that I have used some multiplication principle. My process is that of *superimposition*, and therefore one of addition and not multiplication. Taking the equation of motion in a non-gravitational field as

$$dx^2 + dy^2 + dz^2 + \frac{v^2}{D^2}d\omega^2 = 0, \text{ where } \omega = iDt,$$

we superimpose the influence of gravitation by adding four unkown terms to the equation and get

$$(1 + X)\,dx^2 + (1 + Y)\,dy^2 + (1 + Z)\,dz^2 + \left(\frac{v^2}{D^2} + W\right)d\omega^2 = 0,$$

where X, Y, Z and W are unknown functions.

The critic's assertion that the fourth element should not be W but $-\frac{W}{D^2}$ is not intelligible, as W is an unknown function, and it therefore matters little whether we start by putting a positive or negative sign before it. Nor does it matter in the least whether the form selected for this unknown function is W or $\frac{W}{D^2}$ or $W.D^2$ or for the matter of that any other, as the constant can be easily absorbed into it. Wdw^2 has been chosen merely to resemble Xdx^2, Ydy^2 and Zdz^2; and for purposes of illustration only, as it has not been actually used. It may give a pleasant surprise to point out that in the third paragraph (p. 277) when taking the equation in polar co-ordinates, the unknown function, for a similar resemblance, has actually a negative sign, which the critic would prefer, for $RD^2dt^2 = -Rd\omega^2$. A simpler method is given in Chapter XV, pp. 86–7.

The equation of a body unaffected by gravitation in polar co-ordinates would be

$$dr^2 + r^2d\theta^2 - v^2dt^2 = 0.$$

The equation, when gravitational effect is superimposed upon it, would be

$$(1 + f_1)\,dr^2 + (1 + f_2)\,r^2d\theta^2 + (f_3 - v^2)\,dt^2,$$

where the f's are some unknown functions. From the symmetry round the origin, these must be independent of θ, and as the source is not changing with time independent of t also, and must therefore involve r only; as the gravitational effect is proportional to the mass of the source, these must contain the mass M of the source as a factor; and as the influence must vanish at infinity, these functions when expanded by Laurent's theorem must involve descending powers of r only.

Hence the equation takes the form

$$\left(1 + \sum_1^\infty \frac{A_n}{r^n}\right) dr^2 + \left(1 + \sum_1^\infty \frac{B_n}{r^n}\right) r^2 d\theta^2 + \left(\sum_1^\infty \frac{C_n}{r^n} - v^2\right) dt^2 = 0,$$

where the A's, B's and C's are unknown constants, but known from experience to be small. The rest of the analysis is purely mathematical (see Chapter XV, pp. 86–7).

My attempt in Chapter XIII, Sec. II, pp. 274–77, has been to show that an artificial four-dimensional continuum can be obtained from a spherical wave propagation, and without Einstein's postulate of the absoluteness of the velocity of light. His orbital equation can be obtained with the help of the Tensor Calculus on the basis that $G_{\mu\nu} = 0$. I have also shown that the same equation can be obtained simply even without the help of the Tensor Calculus (pp. 277–79 as modified and simplified in Chapter XV, pp. 86–7). I have further pointed out that as ds is ultimately eliminated from the equation, the postulate of Relativity that $ds = 0$ for light has been unnecessarily thrust into the General Theory.

I get exactly the same result as Einstein so far as the advance of the perihelion of the orbit of a planet is concerned. But so long as the postulate that the velocity of light relative to any moving body, howsoever fast it may be moving and no matter whether light is overtaking it from behind or approaching it from the front, is still equal to the velocity of light, is not abandoned, Einstein's equation governing light is

$$\frac{d^2u}{d\theta^2} + u = \frac{3\mu}{c^2} u^2$$

as against my equation

$$\frac{d^2u}{d\theta^2} + u = \frac{\mu}{h^2} + \frac{3\mu}{D^2} u^2,$$

where $D = c$.

The extra term causes marked differences (1) in the spectral shift of light, which is no longer the same on all points in the solar disc but increases rapidly to double of Einstein's value at the edge, and (2) in the deflection of light which is at least one-third in excess of Einstein's value. The results obtained by Royds at a total eclipse show a cent. per cent. confirmation of my prediction, which is 100% more than Einstein's, and therefore far in excess of any possible error of observation. The results of the observation to test my second prediction regarding the deflection of light from stars are still awaited. If both these predictions were really disproved, I would be the first to abandon my own theory. If proved, my law will stand, even quite irrespective of the question whether the proofs are rigorous or not. If the Michelson-Morley experiment were performed with solar light, instead of terrestrial, the fundamental postulate of Relativity will be really tested.

S. M. Sulaiman.

[1] *Proc. Nat. Acad. Sci.*, **7**, 78–9.

Photochemical Reactions with Some Inorganic Colloids as Active Agents under the Influence of Light in Various States of Polarisation.

It is well known that external forces may cause a transition in colloidal systems from the isotropic to the anisotropic state.

An old and concentrated V_2O_5 sol is isotropic when at rest but when made to flow through a tube, it becomes double-refracting towards a beam of monochromatic light.

Weigert discovered the important fact that plane-polarised light also may act as an external orienting force upon colloidal systems. Thus if a glass plate covered with a thin layer of photo-chloride in gelatine, be exposed to strong plane-polarised red light, the red spot produced, shows dichroism.

Similar action of circularly polarised light has been observed by Zocher and Coper who used thin layers of photo-chloride prepared by chlorinating silver mirrors. Circular dichroism is observed in spots produced by the action of circularly polarised light. It is to be noted that thin layers of these sensitive gels have considerable rigidity of structure and a pattern once produced in such gels will retain its form indefinitely.

Circular dichroism has also been noticed in solutions of optically active molecules, *e.g.*, Kuhn and collaborators observed circular dichroism in hexane solution of camphoric acid. Here circular dichroism

is due to the anisotropic structure of the individual molecules.

Ghosh, Banerjee and collaborators[1] have found for the first time that under certain circumstances, anisotropic structure can be produced in amicroscopic sol particles, if during the process of the coalition of molecules to form the sol particles, the molecules are exposed to circularly polarised light which they are capable of absorbing.

The sols used were tungstic acid sol, chromic tungstate sol, vanadic acid sol, molybdic acid sol, chromic hydroxide sol and uranic acid sol.

After mixing together the sol-forming reagents or after dialysis as was required for the preparation of a sol, each sol was separately matured in (*a*) the dark, (*b*) unpolarised light, (*c*) plane-polarised light (*d*) *l*-circularly polarised light and (*e*) *d*-circularly polarised light. ($\lambda = 3660$ Å.)

Circular dichroism at 3660 Å was observed only with tungstic acid sol, chromic tungstate sol and vanadic acid sol. Following are a few of the interesting data obtained in that connection.

Sol used	Nature of light in which the sol was matured for	Anisotropy factor $g = \frac{(A_l - A_d)}{\frac{1}{2}(A_l + A_d)}$
Tungstic acid ..	*l*-circularly polarised	+ 0·0271
„ „ ..	*d*-circularly polarised	− 0·0221
Vanadic acid ..	*l*-circularly polarised	+ 0·0289
„ „ ..	*d*-circularly polarised	− 0·0054
Chromic tungstate ..	*d*-circularly polarised	− 0·0284

The values of anisotropy factor of optically active substances, as measured by Kuhn and his collaborators, varied from 0·005 to 0·04.

Sols of molybdic acid, uranic acid and chromic hydroxide exhibited no circular dichroism when prepared under these conditions.

The sols which showed circular dichroism when matured in circularly polarised light, gave very interesting results when they were used as reagents in photochemical reactions. For example, if sols of tungstic acid were reduced under the influence of monochromatic radiation (3660 Å) by formaldehyde, glucose, lævulose, lactic acid, mandelic acid, leucine and Na-hypophosphite, it was found that the velocity of reduction, when the sol had been matured in *d*-circularly polarised light and the photochemical reaction subsequently carried under *d*-circularly polarised light, was always less than that observed with the same intensity of *l*-circularly polarised light used for maturing the sol and the subsequent irradiation of the reaction mixture.

Similar results were also observed with the following reaction mixture:—chromic tungstate, glucose, H_2O_2; tungstic acid, one of the previously mentioned reductands, and H_2O_2; vanadic acid sol, glucose and H_2O_2, etc.[2]

The sol systems which show this differential effect are known to contain particles which are micro-crystalline in structure. It is probable that circularly polarised light exercise an orienting influence during the process of formation of these micro-crystalline photo-active aggregates and develops an anisotropic lattice structure. This anisotropy manifests itself as circular dichroism and as a differential velocity effect in photochemical reactions under the influence of circularly polarised radiations. When unpolarised or plane-polarised light is used for the growth of photo-active aggregates, neither circular dichroism nor this differential velocity effect in photochemical reactions is observed, which indicates that the micro-crystalline patterns formed under such conditions are isotropic.

[1] *J. Ind. Chem. Soc.*, 1937, **14**, 495–563; 575–626.

[2] *Vide* Ghosh and Banerjee, *Jour. Ind. Chem. Soc.*, 1937, **14**, 617–626.

REVIEWS.

The Elements of Mathematical Analysis. By J. H. Michell, M.A., F.R.S., and M. H. Belz, M.Sc., Vols. I and II. (Macmillan & Co., Ltd., London), 1937. Pp. xxiii + 1087. Price 84/.

This book is intended to be a treatise which, while meeting adequately the increasing requirements of students of Physics and Engineering in practical analysis and providing the technique required for special problems, should also be sufficiently rigorous to be considered an introduction to pure mathematics. The topics treated in the two volumes cover those usually included in the Honours courses of our Universities—differentiation and integration including multiple integrals, applications to plane curves, Taylor's series, uniform convergence and ordinary differential equations. The needs of the practical computer have been kept in mind by the inclusion of chapters devoted to numerical and mechanical integration, fitting of curves to given data by the method of movements and the method of least squares. There are a large number of examples and in many cases hints are given for their solution.

The authors have introduced a number of new names some of which are expressive and seem worthy of adoption, *e.g.*, one way function (monotonic function), expocyclic function [$e^{ax} \sin (bx + c)$, the product of an exponential and cyclic function].

For a book of 1087 pages in two bulky volumes, intended for students of science and engineering, the range covered seems small, since the applications to geometry do not go beyond the plane curve and no attempt is made to discuss the convergency or the discontinuities of the Fourier development, while the Fourier double integral gets dismissed in an example.

The book should be useful in giving a good grounding in the technique of the calculus and its applications—if our Honours students could afford the heavy price of 84 shillings ; but, as a book in pure mathematics it will require supplementing.

A. N. R.

Relativity. By Augustin Sesmat. (Actualités Scientifiques et Industrielles Series, Nos. 486–92), 1937. (1) *Genese des Théories de la Relativité*, pp. 1–45 ; (2) *Principes de la Théorie restreinte*, pp. 1–83 ; (3) *Les Systèmes privilégiés de la Théorie restreinte*, pp. 1–73 ; (4) *Principes de la Théorie générale*, pp. 1–72 ; (5) *Théorie relativiste de la Gravitation*, pp. 1–89 ; (6) *Les Systèmes privilégiés de la Théorie générale*, pp. 1–24 ; (7) *Essai critique sur la Doctrine relativiste*, pp. 1–52.

The author of these seven volumes has already published another seven volumes in the Actualité Series on systems of reference and motion in classical mechanics, and has now undertaken an examination of the same questions from the point of view of relativistic mechanics. His attitude is mainly historical, critical and philosophic, and the idea is to expose the basic principles of the subject without being too mathematical. Laying aside for the moment his critical evaluation of the theory, it must be said that the exposition of the subject-matter of the theories of relativity is done very well indeed, in the first, second, fourth and fifth volumes of the series. A brief historical introduction to the circumstances under which Einstein was led to formulate his theory is followed up by a sketch of the main steps in the development of the doctrine of relativity, *viz.*, the special theory, the transitional theories, the general theory and later generalisations. The second volume on special theory gives some recent methods of deductions of the Lorentz-transformation by Lalan, Esclangon and E. Leroy. The principles of the general theory are explained in non-mathematical language in the fourth volume, followed by a treatment of special gravitational problems in the next one. Schwarzschild's investigations are given a very prominent place, and treated very fully in view of its applications to the three experimental verifications of the theory. The author's opinion regarding these verifications is that the relativistic explanation of the advance of the perihelion of Mercury alone is satisfactory and constitutes a brilliant success of the theory. Referring to other efforts

towards an explanation of this phenomenon by Newton's theory, he remarks that all such efforts have so far been quite unsatisfactory.

It is, however, the author's critical and philosophic evaluation of the theory that does not appear to us quite convincing. In the introduction to the very first volume of the series, we are told that the main idea is to examine the question whether the systems of co-ordinates in relativity are not privileged, and the conclusion that is drawn is that they are so, contrary to the very fundamental claims of the theory. This question has been examined in the third volume for the systems in special theory, and in the sixth for those of the general theory. The author's division of physical quantities into intrinsic and relative appears misleading, and the definition of mass as measuring the quantity of matter, on which this division is based, is certainly not the correct definition. Equally unconvincing is the division into localisable and non-localisable magnitudes, as well as the assertion that the privileged system used in special relativity is that with respect to which the observer is at rest. It is suggested that an observer measuring a rod in this system S by means of a metre-scale in S′ which is in relative motion gets a "false" measure because the rod and the scale are not in the same time, and that all such diverse scale readings measure a single objective magnitude correct only in S. The explanation of the Michelson-Morley experiment by introducing this proper system is claimed to be simpler than the usual derivation, but a little scrutiny will show that it is a hotch-potch of classical and relativistic ideas.

The conclusions regarding the existence of privileged systems in the general theory are quite similar although not expounded at such great length as in the case of the special theory. It is pointed out that the Schwarzschild system of co-ordinates is a privileged system for the description of the observable universe, but it is difficult to see the point of the criticism when it is remembered that the whole of Schwarzschild's investigation is relativistically invariant. The introduction of an objective universe as would appear with its absolute elements to an omniscient physicist is entirely foreign to relativistic ideas, and it is no wonder that conclusions derived from this absolute standpoint should contradict relativistic principles. It is therefore easy to understand the conclusion that, as far as generalised notions are considered, the general theory of relativity does not deserve the name given to it.

In the last volume which is a critical essay on the doctrine of relativity, the author brings his objections against relativity in a collected form and formulates his conclusions regarding the attitude to be adopted towards relativity. This theory is shown to be inspired by positivism to which he does not fully subscribe. The new definition of time, the postulate of relative motion, and of complete equivalence, the idea of geometry of the universe, and the explanation of phenomena by means of a field theory are mentioned as concepts which cannot be introduced *á priori*. The example is given of the classical movements of gravitation being presented by E. Cartan as spatio-temporal relations obeying a covariant law other objections are that the theory is not harmonised with quantum phenomena; the experimental verifications do not appear to be absolutely decisive; none of the objections in principle against the classical concepts is decisive; even if the relativistic theory is true its philosophic and critical basis is fragile and in principle the complexity of physical phenomena cannot well be explained by simple rigorous theories as is claimed by relativity. To explain the equlaity of dynamical and inertial mass, the author suggests a curious explanation, which he calls as anthropomorphic but nevertheless legitimate, as follows:

"L'Ordonnateur du Monde voulant, après avoir établi des masses de diverse grandeurs, les soumettre à des forces, et décidant, *parceque c'est le plus simple*, que, quelles que soient les forces appliquées, les accélerations subies seraient toujours inversement proportionnelles aux grandeurs mêmes des masses, san aucun autre coefficient pouvant varier d'un cas à un autre." One might well ask why, if the simplicity be the sole criterion, the "Ordonnateur du Monde" should have made physical laws so complex as not to be capable of being explained by simple theories—as the author himself asserts. The final conclusions are that for the present it would be as unwise to declare the relativity theory true and definitive as it is to declare it

false and indefinite; and that from a philosophic point of view the doctrines must be taken with great care—conclusions with which one could certainly agree.

The conviction that we acquire after reading these thought-provoking volumes, is that a great gulf still separates the viewpoints of the physicist and the philosopher, and that this gulf can be bridged only by a great physicist who can think of philosophy in philosophic terms. The volumes under review constitute a solid contribution to the literature of the philosophy of Physics.

B. S. MADHAVA RAO.

Catalytic Processes in Applied Chemistry. By T. P. Hilditch and C. C. Hall. (Monographs on Applied Chemistry. Edited by E. H. Tripp, Vol. II. Chapman & Hall, Ltd., London), 1937. Pp. xxii + 478. Price 25 *s*.

In view of the great strides that the subject has made during the past ten years, the authors have done a great service to their fellow-chemists and to industry by the publication of the second edition of this book. Within its nearly five hundred pages, the book presents an admirably condensed summary of the industrial uses of catalysts and the theoretical aspects of catalytic processes. It has been so lucidly and nicely written that it is, at once pleasant to read and easy to understand. The information given is up-to-date and the practice of giving only a few but important references at the end of the chapters is to be commended in view of its convenience to readers.

The classified lists of catalysts, of the products obtained by using them, and of the processes in which they are employed, given at the beginning of the book serve a very useful purpose. The book is divided into four sections. The first section gives briefly a historical account of the development and uses of catalysts in homogeneous and heterogeneous systems from the early times to the present day and of their mode and theory of action.

The second section which is the most important one and covers more than half the book, deals with catalytic actions taking place at the surface of solid inorganic materials—heterogeneous catalysis. The chapters in this section give excellent resumé of the numerous catalytic processes employed in the large-scale manufacture of many products which are so useful to the community. Instances of these are: production of hydrogen for industrial purposes; production of methyl alcohol (methanol) and liquid hydrocarbons from water gas; the production of petrol by the 'hydrogenation-cracking' of coal, tars and mineral oils, which has been and is receiving serious attention in view of the importance of petrol in times of war; synthetic production of ammonia and other nitrogen compounds, *e.g.*, urea; production of nitric acid by catalytic oxidation of ammonia; production of sulphuric acid by Chamber Process (homogeneous catalysis) and by Contact Process using platinum and vanadium pentoxide catalysts; historical account of chlorine manufacture which is now replaced by electrolytic process; purification of coal gas and making of industrial organic compounds such as formaldehyde, phthalic anhydride, etc.; hydrogenation of fatty oils for edible and industrial uses, and of organic compounds to give reduction products such as menthol, cyclohexane, etc.; the production of phosgene, sulphuryl chloride, and hydrochloric acid, using activated charcoal.

The third section deals with fermentation processes, which, as explained in Section I, are instances of catalytic actions taking place at surfaces of colloidal organic compounds. It includes: the alcoholic fermentation of sugars—production of power alcohol; the acidic fermentation of sugars to yield lactic, citric and butyric acids; the biochemical oxidation of alcohol to acetic acid to produce vinegar; the fermentation of starch carbohydrates to produce butyl alcohol and acetone (the production of the latter by this process in Canada and the U.S.A. proved very helpful during the last War); splitting of fats by lipase in the manufacture of fatty acids and glycerine.

The fourth and the last section deals with technical catalytic processes taking place in homogeneous systems. Some of these are: hydration, *e.g.*, that of acetylene to acetaldehyde; hydrolysis, *e.g.*, splitting of fats by the Twitchell and 'autoclave' methods; condensation, sulphonation oxidation, acetylation; polymerisation of organic compounds to produce synthetic rubber, resins, lubricating oils, etc.

The book is invaluable to students of chemistry as well as to all chemists irrespective of their branch of specialisation in view

of its presenting an accurate, up-to-date, systematic, lucid and admirable survey of catalysts and their uses in the laboratory and the factory.

R. S. THAKUR.

The Chemistry of Synthetic Surface Coatings. By Wm. Krumbhaar. (Reinhold Publishing Corpn., New York; Chapman and Hall, Ltd., London), 1937. Pp. 200. Price. $ 4·00.

Upto comparatively recent times, the art of paint and varnish-making was entirely in the hands of skilled craftsmen some of whom had been considered masters in their fields. Even to-day, some operations such as gum-running are considered to require a highly specialised type of experience and skill. Lately, however, scientists have diverted their attention to the multifarious problems in this field, which stand in need of elucidation. A good measure of success has been attained in this direction and as a result the scope and possibilities of the paint and varnish application have been considerably extended. Dr. Krumbhaar, who has wide experience in this field in more than one continent, has presented in this brief book a short summary of the up-to-date knowledge on the subject.

The complicated reactions taking place in the varnish kettle, the catalytic action of driers, the physico-chemical surface reactions taking place at the pigment-medium boundary, the significance and control of physical properties of the protective coatings have all been dealt with systematically in separate chapters. A final chapter on printing inks is of particular interest inasmuch as printing inks have so much in common with paints and yet the performance demanded of them imposes conditions quite different from the latter. The Appendix deals with examples of specific formulæ for paints and varnishes based on synthetic resins. In view of the fact that we in India are interested more in the utilisation of natural products, the specific reference to synthetic resins may not prove to be technically useful to those interested in paint trade in this country. The main value of the book, however, lies in the fact that the subject-matter has been dealt with in a fundamental and scientific manner. It is, therefore, equally valuable for technologists interested in natural or synthetic products and to scientists interested in the application of fundamental knowledge to industry. Scattered throughout the book one finds a number of suggestions regarding problems which await solution. But unfortunately no references to current literature have been cited, which would have been of great assistance to the student and the research worker. The relatively concise treatment of the subject would permit a great deal of expansion and we hope that Dr. Krumbhaar would be able to undertake the task in the near future.

L. C. V.

Clowes and Coleman's Quantitative Chemical Analysis. Edited and revised by D. Stockdale and J. Dexter. (Published by J. & A. Churchill, Ltd., London), 1938. Fourteenth Edition. Pp. 616; 130 illustrations. Price 18 *s.*

Clowes and Coleman's *Quantitative Chemical Analysis* has been one of the standard text-books in analytical chemistry, and its fourteenth edition has been published after an interval of nearly seven years. The original book has been considerably improved by the revisers D. Stockdale and J. Dexter. The type has been reset and a considerable part of the text has been rewritten, the general arrangement of the volume remaining unchanged. Omissions from the last edition have been few. "The additions include accounts of the estimation gravimetrically and volumetrically of aluminium and magnesium by 8-hydroxyquinoline, the colorimetric estimation of aluminium by 'aluminon', the use of the chromate radical in the estimation of barium, lead and sulphates, ferrous phenanthroline as an internal oxidation-reduction indicator, a brief introduction to the use of ceric sulphate, and the analysis of cupronickel by salicylaldoxime". The section on the analysis of non-ferrous alloys and that on the valuation of manures has been revised and extended. Each section is given a theoretical introduction.

A brief account of the use of the common indicators is given. The use of adsorption indicators like Fluorescein, Tetrazine, Eosin, Rose Bengale, Di-iodofluorescein and Phenosafranine has been referred to. The use of chloramine-T in quantitative analysis has been described. The chapter on the electrometric and electrolytic estimations,

colorimetric analysis, containing some of the standard exercises is to be welcomed in a text-book on analytical chemistry. The authors have given suitable references, in dealing with special topics like the microchemical, spectrographic, conductometric and polarographic methods of analysis. Including, as it does, chapters on the analysis of food materials like milk, butter, beer, wine, spirit, sugar, tea, on the analysis of soap, and on the examination of oils, fats and waxes, the book would be a valuable guide to students of applied chemistry.

The typographical mistake of "diethyldithiocarbonate for diethyldithiocarbamate" on page 401 may be avoided in the next edition. In the section on "Gas Analysis," a description of Orsat's apparatus can preferably be included. The book can heartily be recommended for use as a text-book for B.Sc. students.

In conformity with other publications of Churchill, the printing and get-up of the book are excellent.

K. S. Rao.

The Analytical Chemistry of Tantalum and Niobium. By W. R. Schœller. (Chapman & Hall, Limited, London). Pp. xvi + 198. Price 21/- net.

This monograph is a most welcome addition to the literature concerning the analysis of tantalum and niobium minerals.

The First Part (75 pages) deals with general principles and methods employed in the examination of earth-acid minerals and presents their advantages as well as their limitations.

The Second and Third Parts deal with the quantitative separation methods which include the application of tannin in gravimetric analysis, a procedure with which the author's name is identified very closely.

In this book, Dr. Schœller has presented systematically all the important results obtained by him and his collaborators and published in 33 papers since 1921. Every one engaged in the field of analytical chemistry will find in this book a laboratory companion of the utmost value.

K. R. K.

Introduction to Plant Pathology. By F. D. Heald. (McGraw-Hill Book Company, Incorporated, New York and London), 1937. First Edition. Pp. xi + 579. 200 Figures. Price 24*s*.

Within recent years plant pathology has made rapid strides, and the stimulus to research in this subject has had its origin chiefly in connection with the more practical needs of mankind. As an independent science it now takes an important place on the curricula of agricultural colleges, and numerous text-books have recently appeared to meet the growing need of the undergraduate student who "never completes any work in plant pathology beyond the elementary course." The present book endeavours to supply this need and deals with the subject-matter with less completeness than in the author's standard work entitled *Manual of Plant Diseases*. On the contrary, a number of new chapters have been added and an attempt has been made to stress the economic aspects of plant pathology. On the whole, the book is a well-balanced production with the material arranged in a logical order. The scope of the present work is briefly as follows.

The book is divided into six sections of which the first is introductory, containing five chapters (58 pages) on history, symptomatology, the value of fungi, plant diseases in relation to human affairs and dissemination of plant parasites.

Section II, which comprises 255 pages, deals with the structure of the fungi and diseases caused by fungi, bacteria, phanerogamic parasites and nematodes. The treatment of the diseases in general follows the plan of *Manual of Plant Diseases*, but the material is abridged and rewritten to suit the needs of the undergraduate. The chapters dealing with the diseases are not of much usefulness to the Indian undergraduate since he is not familiar with most of these diseases. To each chapter (excepting the one dealing with phanerogamic diseases) is appended a list of important diseases together with their hosts and scientific names.

Section III is wholly devoted to virus (spelt "virous" in the text) diseases of plants and is divided into two chapters comprising 45 pages.

Section IV, comprising 108 pages, treats of diseases due to a variety of non-patho-

genic causes such as those due to unfavourable soil conditions, unfavourable environment such as air, temperature and light, and injuries resulting from industrial processes and control practices. This section is a compendium of useful information.

Section V, comprising 60 pages, treats of plant quarantines and the various methods of plant disease control including sanitary and cultural practices, seed selection, development of disease-resistant varieties of plants, etc.

Section VI, comprising 22 pages, deals with the methods of studying plant diseases and contains much valuable information for a beginner.

The abundant illustrations, most of which appear in the author's *Manual of Plant Diseases*, add greatly to the value of the text.

B. N. U.

A Guide to Veterinary Parasitology for Veterinary Students and Practitioners. By T. Southwell and A. Krishner. (H. K. Lewis & Co., Ltd., London), 1937. Pp. x + 142 ; 88 illustrations and 12 diagrams. Price 7*s.* 6*d.*

This small book fills a long-felt need of Veterinary students. It presents in a clear and concise form much of the information about Parasites and Parasitism written in a simple practical manner.

The book is written in nine chapters and opens with a description of the Microscope and the method of using it particularly for the examination of parasites. A description of the constituents of blood and some common staining-methods for blood-parasites are also included. Chapters II and III are devoted to *Protozoa* and an immense amount of useful information on these has been crowded into this small section. Chapter IV deals with *Cestodes* or Tape worms, Chapter V with *Trematodes* or Flukes, Chapters VI and VII with *Nematodes* or Round worms. Mention has been made of most of the important parasites encountered in domestic animals under these headings. Each section includes a brief account of the pathogenicity of some of the more important parasites, as well as indication of suitable prophylactic measures which make the book more useful. Chapter VIII gives the procedure of preparing and examining fæces for worm infestation. In the concluding section, *viz.*, Chapter IX, a fund of useful information is given such as, a list of parasites of meat and fish infective to animals, a list of common protozoal and helminthic parasites of veterinary importance encountered in domestic animals and man, a diagrammatic representation of the most important helminth eggs and an interesting series of very cleverly illustrated life-histories of some of the important parasites in animals.

It appears to have been the aim of the authors to produce a book primarily for the use of Veterinary students and secondarily as a reference work for Veterinary practitioners. This is by no means an easy task. Of necessity the student must assimilate a great mass of material in concentrated form. The average student has neither the time, the capacity nor the inclination to absorb a great amount of detailed information. In this respect the authors have done a good job. On the other hand, the Veterinary practitioner may be disappointed at the brevity, with which certain important subjects have necessarily been treated.

On the whole, the book is a credit to both the authors and the publishers and can be particularly recommended to Veterinary students.

P. M. N.

Bacteriology. A Text-Book of Micro-organisms. By Fred Wilbur Tanner. (John Wiley & Sons, Inc., New York ; and Chapman & Hall, Ltd., London), 1937. Pp. xiv + 510 ; 151 text-figures, one plate. Third Edition. Price 17*s.* 6*d.*

No better evidence of the popularity of this book could be asked than the necessity for a revised third edition, hardly a decade after the appearance of the first. The book covers a great deal of ground. According to the Preface, " It is planned for those who are studying Bacteriology for the first time. " Yet it cannot be considered an elementary book. The book provides the fundamentals in as few words as possible without sacrificing clarity or subject-matter; and according to the author, it is really an introduction to Bacteriology and is a more or less complete story in itself of one of the most interesting biological sciences.

The book deals with most of the important parts of the subject and the author has laid equal stress on both the pathogenic and the non-pathogenic micro-organisms. In this respect, it does not suffer from the same weakness which text-books on this subject

invariably do, in which the pathogenic micro-organisms are generally over-emphasized.

The book begins with a brief account of the "History and Development of Early Theories" of Bacteriology and surveys the work of early pioneers like Leeuwenhoek, Kircher, Jansen, Koch, Pasteur, Jenner, Metschnikoff, Lister, etc. The author takes the reader from chapter to chapter through a series of interesting subjects, which include the nomenclature and classification of bacteria, account of molds, yeasts, pathogenic protozoa, bacterial enzymes, action of physical and chemical agents on bacteria, nutrition and growth of bacteria. The author also includes chapters on the carbon cycle, micro-organisms in the air, water bacteriology, sewage treatment, bacteriology of milk and milk-products, industrial fermentation, food preservation, food poisoning and food inspection, relation of bacteria to diseases, transmission of infecting agents, factors influencing infection, modes of bacterial action, immunity and bacteria in plant diseases. Particularly noteworthy is the inclusion of a "Topical Outline for Teachers on Microbiology," in which the author has done credit to his outstanding ability as a teacher of 25 years' experience. The scheme suggested therein should provide useful guidance both to the teachers of microbiology and to students intending to take up a systematic study of the subject.

The whole book is attractively printed and has, besides, a glossary, a full and accurate index as well as an extensive up-to-date bibliography. It warrants the greatest possible support, particularly from students whose ambition it is to acquire a sound foundation knowledge of Bacteriology.

P. M. N.

Practical Zoological Illustrations. Part I. Vertebrates. By S. Lockyer and D. R. Crofts. (Macmillan & Co., London), 1937. 27 Sheets + 1, introduction. Price 10*s.* 6*d.*

This series of illustrations consists of twenty-seven plates containing line and dot figures of some important systems drawn from original dissections made by the authors. They have studied *Scyliorhinus canicula*, *Rana temporaria* and *Oryctolagus* (Lepus.) *cuniculus*. In *Scyliorhinus* the digestive, vascular, reproductory and nervous systems are figured and ten sheets are devoted to them. In one of them (Sheet V) sectional views of the fish in different regions are also depicted. Directions for the complete dissection of the nervous system is also appended. With regard to *Rana*, drawings of the dissections of the alimentary, vascular, reproductory and nervous systems are made and these occupy nine sheets. The first of these gives general directions as to the procedure for dissecting the frog. Sectional views in various regions of a young frog are also drawn. It is to be noted, however, that in Sheet XIX, the denomination of the spinal nerves may mislead the beginner; the first true spinal nerve is absent in the adult frog and therefore the hypoglossal comes to be called the adult first spinal and similarly the brachial, the adult second spinal and so on. Either the authors must label the nerves as 'adult first spinal' and 'adult second spinal' and so forth for the succeeding nerves or call the hypoglossal, the second spinal and the brachial, third spinal. The vascular system in *Oryctolagus* is delineated in suitable colours; the dissections of the neck nerves, brain, alimentary canal and reproductory systems are also drawn. A large dissected view of the mammalian heart (sheep) is figured showing the valves and the passage of blood by suitable arrow marks.

The drawings are faithful representations of the dissections and as the authors themselves remark, are bound to tempt the students to copy them rather than make them draw from their dissections. At any rate, they will be very useful in the comparative study of Indian forms.

We have no hesitation in recommending this useful series to find a prominent place in every zoological library.

L. S. R.

Porifera. By M. Burton. *Bulletin of the Madras Government Museum* (N.S. Natural History Section, Vol. I, No. 2, Pt. 4), 1937. Pp. 58. 9 Plates. Rs. 1-14-0.

This publication is a supplement to the volume on the Littoral Fauna of Krusadai Island in the Gulf of Manaar issued in 1927 under the joint auspices of the Natural History Section of the Madras Museum and the Madras Fisheries Department, and should prove very useful for students working at the Biological Station, Krusadai Island. The author deals in detail with all the species of sponges known from this interesting area, with notes on their classification

and methods of preparation for microscopical examination, etc. The detailed bibliography and 9 plates of illustrations of the spicules of different species should serve not only for the identification of various forms known from Krusadai, but also for most Indo-Pacific species. The editor's appendix at the end gives lists of localities and notes on the colour in life of various species of sponges.

Such systematic publications are badly needed for other areas and on other classes of the animal kingdom, and it is hoped that workers in different parts of India will take up the collection of materials with a view to the preparation of such hand-books.

The Rengma Naga.—By J. P. Mills, I.C.S., (Macmillan & Co., London), 1937. Pp. 381. Price $ 25.

By publishing this volume Mr. Mills has covered a large block of Naga tribes living in contiguous territories, for which both the author and the Government of Assam for financing the publication, are to be sincerely congratulated. The Rengmas, though small, are an important branch of the Nagas and are divided into Western and Eastern sections. The former are being increasingly subjected to missionary influence but the Eastern section, who form an isolated group on the Burma frontiers are cut off from all communications with the parent stock by high mountain ranges and the intervening Sema and Angami villages. They have been brought under administration during only the last fourteen years and retain much of their tribal customs and fighting habits. In this they provide a contrast to the Western group and give splendid opportunities for studying the effects of acculturation which unhappily has not always been conducive to tribal well being. How the reformist spirit is to be tempered with caution and a knowledge of the tribal life, is shown by Mr. Mills (pp. 208–9) in the possible injurious consequences of the discouragement of paying the brides' prices by the Baptist Mission among the Kukis. The bride's price is a compensation for the bride's leaving the clan, and among tribes, such as the Angamis, where it does not exist, orphan girls are left to their fate who often drift to the bazaar to become prostitutes. Such a thing is impossible where the girl is worth a good sum of money and is well looked after by the clan, and is one of the reasons which account for the small number of prostitutes among the Sema, Lhota and Rengma Nagas. It is to be hoped that Mr. Mills' book will serve as an eye opener to Missionary Societies working among tribal groups, and leave them to work out their own method of adjustment to changing conditions.

With his usual thoroughness and intimate acquaintance with all phases of the Naga life, Mr. Mills has described the customs and habits of the Rengma Nagas which can only be described as a model work of its kind.

Mr. Mills does not find evidence of a three-fold division among the Rengma, but traces of dual organisation, which judging from the privileged position of mother's brother, may not improbably be based on a matriliny, though descent is now counted on the male line (p. 137).

The Rengmas, like some of the other Naga tribes still erect stone monuments over their dead and provide yet another link in the chain of evidence which made Hutton to suggest a separate source of origin for the Megalithic Culture of Assam from South Western China, as against that of the mainland of India.

B. S. GUHA.

Social and Physical Anthropology of the Nayadis of Malabar. By A. Aiyappan. (Madras Government Press.) Price Rs. 3/2.

It has been a long established tradition, unique amongst Indian museums, of the Madras Government Museum for the officers of the Museum to study tribes of lower culture in the Madras Presidency and to present the results of such study in the form of a bulletin. In the present study Dr. Aiyappan has not only kept up the tradition but has improved upon it; he has given us a comprehensive survey of the Nayadis of Malabar.

The Nayadi is first described in his social setting of his Hindu and Non-Hindu Neighbours. His material culture, his special skill in hunting and trapping, his chief occupation, namely, begging, his ways of personal decoration, are described. His social organisation, domestic ceremonies and customs, and religion and magic are also analysed so that the reader gets to know his Nayadi as a living unit of a group. Dr. Aiyappan has also given us

his findings regarding the work of the reclamation conducted among the Nayadis. The physical anthropology of the Nayadis is also suitably dealt with.

Dr. Aiyappan does not regard the Nayadis to be tainted by any criminal tendencies, nor hopeless as human material. He records their feelings that they are the victims of the Hindu social organisation. Orthodox Hindu leaders would be well advised to study such books and such peoples before they sing unadulterated praises of their beliefs and institutions.

As a scientific piece of work there are in it a few defects which may be pointed out. Reading the description of dress, the reviewer has not been able to get a complete idea of it, particularly of the female dress. Comparing the averages of nasal index, as computed by various workers, the conclusion that he draws, *viz.*, that the data of Thurston and Fawcett are defective, is not justified. He gives the usual terms of kinship, and it would have been very valuable if he could have told us the maximum ascendent and descendent generations that are remembered by the Nayadis and given us the terms, if any, for any ascendent beyond the grandfather and descendent below the grandchild. It would have been better if Dr. Aiyappan had pointed with respect to many a term in Appendix II, that they are of Sanskritic origin.

G. S. GHURYE.

Electrotechnics, No. 10. (Indian Institute of Science, Bangalore), 1937. Pp. 118. Rs. 2.

This number of the *Journal of the Electrical Engineering Society* of the Indian Institute of Science, Bangalore, edited by Prof. Kenneth Aston, M.I.E.E., keeps up its usual high standard. It is divided into two parts: In Part I the activities of the Department of Electrical Technology of the Indian Institute of Science, Bangalore, are reviewed. Part II contains a number of useful articles of technological interest. One of the outstanding articles is entitled "Some Troubles with Commutation" by Prof. Miles Walker, the well-known authority on Machine Design. Another very useful contribution is that by Prof. K. Aston on "The Principles of Sound Engineering Practice". In this article, the factors which make for soundness and efficiency in engineering production are fully discussed. There is also a very important article on "Treatment of Electrical Shock" which deserves wide publicity. Another noteworthy contribution is one entitled "Radio Receiver Problem in India," in which detailed description is given of the design and construction of a cheap local-station receiver for A.C. mains, corresponding to the German *People's Receiver*. Selectivity, sensitivity and fidelity curves are reproduced which show a satisfactory performance. The total cost including the Loud-speaker and Cabinet is approximately Rs. 60. No doubt, mass production would lower the cost-price appreciably. The get-up of the volume is of high standard and at the price of Rs. 2, it is full value for money.

T. S. R.

A Brief Introduction to the Use of Beilstein's Handbuch der Organischen Chemie. By Earnest Hamlin Huntress. Second Edition. (Chapman and Hall, Limited, London), 1938. Pp. x + 44.

The last edition of this *Introduction* appeared in 1930. The fourth edition of Beilstein's Handbuch is now complete for all ordinary purposes and the appearance of a second edition of this *Introduction* to its use, is opportune. The charts and explanations in the first edition which were confined to the then published volumes of Beilstein have been brought up to date and type questions and problems in the use of Beilstein, have been incorporated. This presentation in English of the scheme in Beilstein's plan of classification should prove of assistance to students of organic chemistry.

S.

Le Champ Moleculaire dans les Dielectriques (Le sel de Seignette). By I. V. Kourtschatov. (Actualités Scientifiques et Industrielles, No. 338. Herman et Cie, Paris), 1936. Pp. 46. Price 12 *francs*.

Phenomena closely analogous to ferromagnetism are found in the domain of dielectrics. Rochelle salt (also known as Seignette salt) is a remarkable case in this connection, and even as ferromagnetic substances are characterised by high permeability, so also Rochelle salt exhibits a dielectric constant running up to 200,000. This phenomena has been called "Seignoelectric" and there is a profound similitude between the physical natures of the two

cases. It would also appear that these seignetoelectric bodies form a unique class of solid dielectrics whose properties are well interpreted by Debye's theory. The region of spontaneous orientation for the pure salt is between -15° and $+25^{\circ}$ C. The author who has done extensive work on this subject, presents here the whole field of investigations and results obtained hitherto, in a very clear and interesting manner. The subject is however by no means cleared up, and needs considerable elucidation for a clear understanding of the molecular kinetics in these solids.

M. A. G. RAU.

Le Polymorphisme des Acides Gras. By F. Dupre La Tour, S.J. (Actualités Scientifiques et Industrielles, No. 424. Herman et Cie, Paris), 1936. Pp. 53. Price 14 *francs*.

This brochure presents an original work, a number of results appearing here for the first time. The fatty acids, both mono and di-, show essentially two principal types of structure, one type a with $\frac{a \sin \beta}{b} \sim 1{\cdot}5$, and the other type β with $\frac{a \sin \beta}{b} \sim 0{\cdot}66$. In general, the a type configuration is more stable than the β type. The transformation temperatures are definite, the transitions being in some cases easily reversible, in others not. The author has followed these transformations by X-ray analysis at different temperatures, and has presented a very interesting aspect of polymorphism which raises a number of interesting questions concerning the equilibrium of molecules in the crystal. The brochure is well worth a close study by all interested in the general question of structure of matter.

Bâlatrikônamithi. *A Primer of Trigonometry.* By M. V. Jambunathan. (M. V. Seshadri and Co., Bangalore), 1937. Pp. x + 91. Price, Calico bound, 12 as., ordinary 8 as.

The book represents the first four chapters of a text-book of Trigonometry in Kannada, and covers the syllabus of the S.S.L.C. Course. It is a very creditable performance, the presentation being simple and full, and the worked examples very instructive. Graded problems are given at the end of each chapter. Tables of sines, cosines and tangents to four figures are included and these are also for sale separately. The book may confidently be recommended as quite suitable for the pupils for whom it is written.

Regarding the language, a few remarks may not be superfluous. The style is simple and natural and the Kannada technical terms are also apt on the whole. But some are not so happy, *e.g.*, ವಿವರಗಳು for co-ordinates (ಸ್ಥಾನಸೂಚಕಗಳು would be appropriate), ಪದ for quadrant (ಪಾದ is correct), ನಿಷ್ಪತ್ತಿ for ratio (ನಿಷ್ಪತ್ತಿ means production; ಪ್ರಮಾಣ has been used by many for ratio and is correct), ಸ್ಪರ್ಶಜ್ಯಾ for tangent (why does the ಜ್ಯಾ come in?), ಸಜಾತೀಯ for similar (ಸದೃಶ is better), ತೀರಿಸು, ತೀರಿಕೆ for 'to solve' ('solution') (ತೀರಿಸು means to end, to complete; ಪೂರಣ as in ಸಮಸ್ಯಾಪೂರಣ may do; ಸಾಧಿಸು may do also for 'to solve'), ಕರ್ಣ, ಅರೆ for 'radius' (ತ್ರಿಜ್ಯ alone will do), ಉನ್ನತ ಕೋಣ for angle of elevation (ಉನ್ನತಕೋಣ means elvated angle, say ಉನ್ನತಿಕೋಣ), ಸಮತ್ರಿಕೋಣ for right-angled triangle (it will be confused with ಸಮತ್ರಿಭುಜ used for equilateral triangle; say ಕಾಟಿಕೋಣತ್ರಿಕೋಣ) and so on. Some turns of expression and usage such as ನಂತರ, ವ್ಯಧಿಸಿ, ಏಕಾಂತ್ಯ, ನೋಡಿ ಪರಿಲೇಖ (for ನೆ ಪರಿಲೇಖವನ್ನು ನೋಡಿ), ಆಂಗಗಳು ಕೊಟ್ಟಿದೆ, ಪಾತಳ, etc., are not appropriate and are against Kannada idiom. In Sanskrit ಶರ has been used for versed sine (the height of a chord in fact). Here the author uses it for secant. Even if he so uses it, it is not right to say that the ancients used it in this sense. We have noticed a few misprints, *e.g.*, on pp. ix, 12, 35, 51, etc. We hope these remarks will be taken in the spirit in which they are offered, and we expect to see the book appear soon in a second improved edition.

Field Sciences of India.

An Outline of the Field Sciences of India, issued by the Indian Science Congress Association on the occasion of its Silver Jubilee meeting gives within a compass of about 160 pages a general view of the results of studies in India of Meteorology, Oceanography, Geology, Botany, Zoology, Ethnology, Agriculture and Archæology. There are thus eight chapters, each shared by one of the above branches of science and contributed by well-known workers in the field who could speak with authority in their respective branches of study.

The weather of India forming the topic of the first chapter brings out clearly the great diversity of meteorological conditions which prevail in different parts of this vast sub-continent; the range in rainfall varying from as low as 5 inches in the Rajaputana Desert to as much as 430 inches at Cherapunje in the north-east and the range in temperature, from −49° F. recorded in Kashmir to 126° F. often registered at Jacobabad. The humidity likewise differs very greatly in the several parts of the country at different seasons of the year. The seasonal variations known as the Monsoons, impart distinctive and contrasting meteorological conditions at different parts of the year. The north-east monsoon during the winter third of the year is a season of winds of continental origin and great dryness, whereas the south-west monsoon, during the summer third is one of much humidity, cloud and frequent rain. Between these principal seasons are the hot-weather months (April and May) and the retreating south-west monsoon (October and November). Two important tables, one of the monthly and annual rainfall in the several districts, and the other of the average maximum and minimum temperatures of a number of stations are included in the outline and they will prove useful to the field worker.

In the next chapter, the Oceans around India are dealt with and a comprehensive account is given of the topographical and geological aspects of the sea-floor, the various kinds of marine deposits, the important hydrographic features and the nature of plants and animals which are found in the seas. The nature and disposition of the important submarine ridges in relation to the surrounding floor of the oceans and the continental trends are described in detail and the Bathymetric chart of the Indian Ocean gives a very helpful picture to follow the descriptive account. The knowledge available in respect of the geology of the sea-floor though "extremely little," suggests that the Carlsberg Ridge and its continuations—the Mid Indian Ridge—are of volcanic origin throughout their length. The age of the submarine mountain system is also suggested to be the Tertiary Period. The observations made of the coastal strips are in agreement with the theory of extensive scarp faulting and submergence of land on the coast, put forward by the geologists. The outstanding feature in the hydrography of the Indian Ocean is the stratified nature of its waters as we pass from the surface to the bottom—each strata being characterized by the temperature and salinity of the water as well as the amount of oxygen dissolved in it. Each stratum is in a state of continual movement and recent work has shown that there are at least four and possibly five such strata. In addition, in the Bay of Bengal and the Andaman Sea, a periodic to and fro swing or "Seiche" occurs in deep water in certain seasons of the year. The influence of these various ocean currents on the distribution of the marine animals and plants is briefly discussed.

The Geological History of India is outlined in the succeeding chapter. The geology of India falls naturally into three broad physiographic divisions of totally dissimilar characters. The first of these divisions—the Indo-Gangetic Plains—though of much importance from a historical and agricultural point of view, is the least interesting geologically and the formations therein consist essentially of an immense thickness of alluvium of the Pleistocene Period. The second, known as the Peninsular India, is a segment of the earth's crust that has stood firm and resistant over a vast period of time amidst all the revolutions that have again and again altered the face of the earth. The only structural disturbance it has suffered is in the nature of faults and factures—some of which have indeed been responsible for the formation of an important coal producing system

known as the Gondwana system of the Palæo and Mesozoic Period. The Peninsular India has also had some marine transgressions towards the close of the Mesozoic. By far the largest part of this division of India is however covered by the Archæan rocks and the vast spread of the Deccan Trap of the late Cretaceous or early Tertiary times. The Extra-Peninsular India, on the other hand, has been a weak and comparatively flexible portion of the earth's crust and has undergone a great deal of crumpling and folding giving rise to the Himalayan and other mountain ranges. This region has been underneath the sea for the greater part of its history and has a succession of strata characteristic of all the geological periods from the Cambrian onwards. The Siwalik system (lower Miocene to lower Pleistocene) of this region is famous for its wealth of the mammalian fossils. The rock formations, representative of all the various geological periods that are found in India, are briefly reviewed in relation to their fossil contents, the physiographic changes that took place and the effect on topography that the rock systems have produced. The important economic minerals associated with the systems are also mentioned. A short account of the two type areas for geological study in India —the Salt Range and the Kashmir Valley— is also added.

The chapter on the Vegetation of India gives an outline of the Indian flora. When the great variations in the physiographic and climatological features of India are considered, the variety and wealth of the Indian flora is easily appreciated. However, the outstanding feature of the flora of India is that none of the families of flowering plants is peculiar to it. Of the several elements of the flora, the Malayan is dominant. The African and to a still higher degree the Australian and American elements are less well represented than the European and the Middle East floras. The Tibetan and Siberian floras only reach India in the Alpine regions of the Himalayas but the Chinese and Japanese floras are strongly represented, in its temperate belt. Of the indigenous flora, the palms are less diverse in specific characters than in the Far Eastern and other regions. The bamboos are nearly everywhere important and there are several species of the endemic figs. The conifers are entirely confined to the areas of the north Indo-Gangetic divide. The various types of the vegetation of the forests and that of the several botanical regions such as the Himalayas, the Indus and the Gangetic Plains, Malabar and Deccan are briefly described.

The zoological aspects of the field studies receive consideration in the succeeding chapter on the Fauna of India. The birds and insects have attracted much attention in India on account of their great variety and common occurrence all over the country and no less than 2,300 species and subspecies of birds have been recognised. The interest evinced by some people in blood sports has stimulated accumulation of much knowledge of the beasts of forest tracts and the lesser jungles. The marine and fresh-water forms are also well known. The main characters of the Indian animal life are outlined with reference to the several natural orders. An account of the various animal communities that have established themselves in caves, hill-streams, estuaries and desert tracts is given. These animals show considerable powers of adaptation which their congeners in other localities lack. Reference is also made to certain rare and interesting elements of the Indian fauna which have a more or less restricted area of distribution.

The pre-historic and early culture of India is discussed in the Outline of the Racial Ethnology. The available evidences on the racial types of man during pre- and early historic times are little and deal only with a small section of India's racial history. Considering India's topographical features, man could only have reached this country through the gaps in the mountain chains on the western frontiers, perhaps to a very small extent through the eastern side, but we have very few relics of the Early man's handiwork recorded from these parts. In Central and Southern India, however, ample evidence of human occupation such as rolled flakes and well worked hand-axes resembling those belonging to the Acheulean culture of Europe were found in the boulder conglomerate stage about the end of the second Ice Advance. Succeeding this after a long erosion interval was the "Soan Culture" which has been identified as typographically allied to Moustierian flake industry of Western Europe. Over the remains of the Soan culture abundant evidence was also discovered of Microlithic,

Proto-Neolithic and early Neolithic industries. We have, however, no trace of the skeletal remains of the Early man associated with these finds. The skeletal remains that are referable as landmarks in the racial history of India are those belonging to the Indus civilization between the third and second millenia B.C. The remains during the Chalcolithic times in the Indus Valley, point to a population which consisted in the main of moderate statured people with long head, narrow prominent nose and long face but not physically very powerful. There was also another race of powerful build and tall stature possessing an average cranial capacity larger than that of the modern European. The pre-historic sites so far excavated in Central and South India, are all associated with Iron, and are probably of a much later date. The majority of skulls from Aditanallur, one of the South Indian localities, discloses a dolichocranial and mesorrhine type not unlike the one which underlies, in a large measure, the present Indian population. The ethnic composition of the present day is also described in the outline, according to the various racial types.

The chapter on Agriciulture and Animal Husbandry deals with the importance of irrigation, the chief types of soils, the nature of the agricultural implements and manures. India has a population of 338 millions and a cultivable land of about 450 million acres. The dominating factor in the economics of Indian agriculture is the smallness and fragmentary character of the holdings which form the very basic living industry of the country. The peasant and his family work their lands, the village itself providing the additional labour that is required at certain times. Despite the large number of animals kept, mixed farming in the European sense of the word has been little developed. "The Indian Budget has frequently been described as a gamble in rain"—the cropping and system of agriculture being dominated by the character of the monsoon. Irrigation also plays an important part and India is the greatest irrigation country in the world. Out of the 280 million acres of cultivated land, no less than 60 million acres are on the average being irrigated from one source or the other like the canals, wells, tanks and streams. Four main soil types can be recognised in India—(1) the Red soils derived from the Archæan system, (2) the Black cotton soil, (3) the Indo-Gangetic alluvium, and (4) the laterite soils. The cultivating implements of the peasant are few and simple,—the wooden plough with an iron steel point. The small iron ploughs are recently being used in large numbers. India is rather backwards in manuring. The value of composting is being appreciated. Green leaf, oil-cake and other manures are also used. Chemical manure is also being imported largely. The main features of the principal crops such as rice, wheat, pulses, sugarcane, cotton, etc., are dealt with in the outline giving the statistical figures for each of them.

The livestock industry is worth annually to the country no less than Rs. 1,300 crores, the bulk of which is mostly distributed equally between cattle labour in agricultural and other purposes, and the diary products. Manures also contribute an appreciable part. The approximate composition of India's livestock population including the States and Burma for 1935 census showed a grand total of 316 millions, out of which some 70% are all in Bovines (ox-tribe and buffaloes) and the rest of other animals such as sheep, goat, etc. Considerable attention to the Veterinary Science has been devoted in India and thanks to the latest discoveries of the Muktesar Research Institute, two methods of vaccination with a goat virus of fixed virulence have provided an inexpensive means of conferring lasting immunity against rinderpest. Systematic control measures are also in operation against the other cattle plagues. Much attention has also been paid in recent years to the problem of animal nutrition both from the economic and health standpoints.

The Outline of Archæology, forming the last chapter, gives a brief resume of the story of India's culture, art and architecture, as traced through the Ages, commencing from the Stone Age down to the Islamic period of History. The Mohenjodaro, the premier city of Sind, is the oldest and the best preserved site in India. The origin of every aspect of Indian art and culture has now been traced to the Mohenjodaro times. The famous limestone statuette of bearded man is the earliest attempt in Indian culture. The biggest hoard of pre-historic metal implements come from Gungeria of the Central Provinces. Subsequent to this Copper Age in Northern India, an epoch

from about 2,500 B.C. to 500 B.C. is a strange gap in India's cultural unity, but the immigration of the Aryans into India and their colonization may be fitted up somewhere into this period. The Mauryan art and architecture, the Graeco-Buddhist school of Gandhara, the western caves of India and the Brahminical temples in Western and Southern India have helped to give us a wealth of information to study India's more recent historic culture, art and architecture.

The foregoing accounts in the various chapters are suitably illustrated with a number of maps, sections, sketches and photographs. Those who wish to seek for more information will find the bibliographical references given at the end of almost every chapter very helpful. Investigation conducted in India in Geodetic Science has somehow failed to find a place in this excellent self-contained outline of the field sciences of India. However, the coloured orographic map of India inserted to form the frontispiece, " should enable the readers not only to locate the various places referred to in each chapter but will also give a clear idea of the physical features of the country, a knowledge of which is absolutely essential for a proper study of the field sciences ".

This composite publication—which so materially differs from any ordinary Gazetteer type both in the selection of its subject-matter and in the manner of its presentation, was meant to help the foreign delegates attending the Science Congress, to a proper appreciation of the manifold problems involved in the study in India of several field sciences. A glance through, clearly indicates that the book has amply fulfilled the original intention of the author of this scheme of publication. As pointed out in the Editorial Preface, the compendium will also have a much wider appeal to specialists and to the students of science in India—to the former because of its influence in creating a broader outlook and promoting co-operation amongst the workers in the various branches of science which involve an essentially " out-of-door " study ; to the latter because of the excellent manner in which it summarises within the range of a few small pages the vast amount of information scattered in the various official and other publications that have appeared from time to time.

The printing and get-up of the book is very good.

M. B. R.

CENTENARIES

By S. R. Ranganathan, M.A., L.T., F.L.A.
University Librarian, Madras

Palmer, Henry Spencer (1838–1893)

H. S. PALMER, a royal engineer, was born at Bangalore, April 20, 1838. Having received his earlier education at private schools in England, he obtained admission to the British Royal Military Academy at a public competition in 1856.

His Career

Palmer was first appointed to the expedition to British Columbia (1858–1864) and was actively engaged in making surveys and explorations and was given a share in the construction of roads and bridges. From 1864 to 1873, he worked in the ordnance survey, except for a short visit to British Columbia in 1868–69 to survey the Senai Peninsula. In 1875, he assisted the New Zealand Government in placing the provincial surveys on a scientific basis. After serving in the Barbodas for a short while, he went to Honkong in 1878 and served there in various capacities till 1882. In 1884, his services were requisitioned by the Japanese Government for the construction of various water works and harbour works. Accordingly, he spent the last decade of his life in Japan.

His Scientific Work

In 1874 he was nominated the chief astronomer of the New Zealand party appointed for the observation of the transit of Venus. His industry and achievements were highly praised by Sir George Airy, the astronomer-royal. While at Honkong he designed a physical observatory, which is

said to be a model one. He also made an exact determination of that station in 1882.

Singing Sands

In his survey of Senai, Palmer made a special study of the Jebal Negus, which is a high sand slope about 200 ft. high and 240 ft. wide at the base, with an inclination of about 30°. Sandstone cliffs overhang it and bound it partially on either side. Excavation was impossible on account of the continuous flow of sands when disturbed. Palmer found by experiment that when surface sand, at a temperature of 103°, exposed to the sun's full glare, rolled gradually down the slope in thin waves an inch or two deep, there is heard, at first, a deep, swelling, vibratory moan, rising gradually to a dull roar, loud enough, when at its height, to be almost startling. Palmer communicated the results of his investigation to the British Association Meeting (1871) at Edinburgh. It is said that there is a similar singing sand slope at Reg. Ravin, forty miles north of Kabul. An exact explanation of this curious accoustic phenomenon is not yet said to have been given.

According to a quaint native legend founded on the former monastic occupation of this part of Senai, the sounds are said to proceed from the *Nagus* or " wooden gong " belonging to a monastery buried beneath the sand.

While engaged in designing an extensive system of graving docks and a repairing basin for the Yokohama harbour, Palmer died suddenly at Tokio, March 10, 1893.

Hyatt, Alpheus (1838–1902)

ALPHEUS HYATT, an American zoologist, was born in Washington D.C. April 5, 1838. His father being a leading merchant of the place, he was given every educational advantage. Under the influence of an early teacher, he was attracted to fossils and natural history. He entered the Yale College in 1856. But his mother, who desired him to become a Roman Catholic priest, sent him to Rome, hoping that the proximity to the Papal Court would serve her purpose. But Hyatt determined to devote his life to science. He returned to America in 1858 and began to study engineering. But he soon came under the influence of Louis Agassiz and took up the pursuit of natural history. Hyatt's admiration for Agassiz went so far that he is said to have learnt his famous *Essay on classification* by heart. He graduated from Harvard in 1862.

His Career

Having served in the Civil War, he returned to Cambridge, Mass. and again took up scientific work, having been placed in charge of the fossil cephalopads in the Museum of Comparative Zoology. In 1870 Hyatt became the custodian of the Boston Society of Natural History. He was Professor of Zoology and Palæntology at Massachussetts Institute of Technology from 1870 to 1888 and he also taught the same subjects at Boston University from 1877 to 1902. In addition he also conducted the Teachers' School of Science of the Boston Society of Natural History from 1872 to 1902. He assisted in establishing the Peabody Academy of Sciences (1867) and in founding the *American naturalist*, of which he was one of the editors from 1867 to 1871.

His Contributions

Recognising the great value of first hand contact within the laboratory with animal forms, he helped in the foundation of the Wood Hole Marine Biological Laboratory, which is the chief of its kind in America and he also became its first President.

His chief contribution to thought was in establishing exact methods of investigation in phylogenic and ontogenic studies. While his terminology was technical and sometimes made his writings hard for a beginner to read, his ideas were remarkably stimulating. The principles he enunciated constitute the foundation of a young and vigorous school of evolution, which is making itself felt in the scientific world. His basic paper on the subject is entitled the *Phylogeny of the acquired habit* and it came out in the *Proceedings of the American Philosophical Society* in 1894.

Hyatt was active to the last moment. As he was on his way to attend a meeting of the Boston Society of Natural History, he died suddenly of heart failure, January 15, 1902.

Billings, John Shaw (1838-1913)

JOHN SHAW BILLINGS, an American surgeon and librarian, was born in the State of Indiana, April 12, 1838. As a boy, John read voraciously and made an agreement

with his father to waive all claim to an inheritance in favour of his sister, if his father would help him through college. He graduated at Mimi University in 1857 and at the Medical College of Ohio in 1860. During the Civil War he served as a surgeon from 1861 to 1864. In the latter year, he was transferred to the Surgeon-General's Office. After retirement from this office, some thirty years later, he became the director of the New York Public Library, which was just then formed, and continued in that position till his death.

His Contributions

(1) *Hospitals.*—About 1873, John Hopkins of Baltimore died, leaving a generous endowment for a great hospital. The trustees asked five experts to design the building and sketch out the organisation. The plans of Billings were accepted and Billings became the medical adviser of the trustees. In this capacity, he prepared a series of reports upon hospital construction and organisation and the relation of hospitals to the training of nurses and medical men, which have become classical. In one of them he wrote "A sick man enters the hospital to have his pain relieved—his disease cured. To this end the mental influences brought to bear upon him are always important, sometimes more so than the physical. He needs sympathy and encouragement as much as medicine. He is not to have his feelings hurt by being, against his will, brought before a large class of unsympathetic, noisy students, to be lectured over as if he were a curious sort of beetle....In this hospital I propose that he shall have nothing of the sort to fear". With these words Billings swept away the old fashioned clinical lecture.

(2) *Preventive Medicine.*—Billings was also a pioneer in preventive medicine. He was one of the original members of the American Public Health Association (1872). His persistent efforts to root out the alarming epidemic of yellow fever won for him the presidentship of that Association (1879). He specialised in vital statistics, which is an indispensable foundation of preventive medicine. He was in charge of the vital statistics of the censuses of 1880 and 1890. In this capacity, he introduced corrected death rates and life tables. He is said to have been the first to suggest the possibility of mechanical methods of tabulation.

(3) *Medical Bibliography.*—It is not without significance that Andrew Carnegie selected him as one of the foundation trustees of the Carnegie Institution of Washington. Speaking at the Billings Memorial Meeting at the New York Public Library, Osler said, "Years after the iniquity of oblivion has covered Dr. Billings's work in the army, as an organiser in connection with hospitals, and even his relation to this great library, the great Index will remain an enduring monument to his fame". He added "There is no better float through posterity than to be the author of a good bibliography". The reference in these remarks of Osler are to

(i) the *Index medicus* which was planned and founded by Billings and Fletcher in 1879 as a monthly guide to current medical literature and of which they were joint editors for the first twenty years; and

(ii) the *Index catalogue* of the library of the Surgeon-General's Office, of which 49 volumes have been published so far at a cost of about Rs. 49,00,000.

This *Index catalogue* is pronounced on all hands as "America's greatest contribution to medicine". As the first librarian of the library of the Surgeon-General's Office, who conceived the idea of such a catalogue, who planned it sixty years ago in a way that is still pursued as the most helpful one and who brought out the first sixteen volumes under his own direction, Billings is rightly claimed to be "America's greatest bibliographer". When Billings was nominated for membership in the National Academy of Sciences, his claim to this high distinction was founded by his friends upon his application of skill in scientific classification.

A Rare Fulfilment

In some reminescences of his younger days, Billings speaks of his student aspiration, "to try to establish for the use of American physicians a fairly complete library and in connection with this prepare a comprehensive index which should spare medical teachers and writers the drudgery of consulting thousands or more indexes or the turning over the leaves of many volumes to find the dozen or more references of what they might be in search". The opportunity he craved when young came by a singular good fortune into his possession in 1864 when he was appointed the first librarian of the library of the Surgeon-General's Office (now known as Army

Medical Library). Billings took charge of the library with less than 1,000 volumes and left it with 300,000 volumes. Its stock is now fast approaching 1,000,000 volumes, constituting the biggest medical library in the world.

To keep abreast of a library growing at that rate and to index its contents closely would require an unfailing fund of energy and an industry which would never need the refreshment of idleness. Billings had that rare gift—the industry of the minute. When somebody suggested to him "the need for leisurely play and the exercise of open air sports, he said that he obtained recreation by turning from one form of brain use to another. That was play enough".

Billings died of pneumonia after an operation, March 11, 1913.

ASTRONOMICAL NOTES.

Eclipses.—There will be two eclipses occurring during May, both of them invisible in India;—a total eclipse of the Moon on May 14 and a total eclipse of the Sun on May 29. The line of totality of the solar eclipse lies in the southern part of the Atlantic Ocean.

Planets during May 1938.—Venus will be a bright object visible in the western sky soon after sunset; Mercury can be seen as a morning star throughout the month: on May 4 it will be stationary and on May 19, its elongation from the Sun will be greatest (25° 37′W.), when it will be visible for nearly an hour and a half before sunrise.

Mars, although not favourably placed for observation, can still be seen low down in the western sky at sunset. A very close conjunction of the planet with Venus will take place on May 8, the angular distance between the two being only about two minutes of arc. Jupiter rises about midnight and will be a conspicuous object in the sky in the latter part of the night; on May 22, the planet will be in quadrature with the Sun. Saturn will continue to be visible as a morning star rising about three hours before sunrise. Uranus passes conjunction with the Sun on May 4 and towards the end of the month can be seen low down in the eastern sky a little before sunrise. It will be about a degree to the north of the star σ Arietis. Neptune is situated in the constellation Leonis very near the star σ Leonis (magnitude 4·1).

The minor planet Vesta will be in opposition on May 21 and can just be seen with the naked eye, its magnitude at the time being 5·9. It will be moving in the constellation Scorpio and can be picked up midway between the two-third magnitude stars ϵ Ophinchi and β Scorpii.

The Variable Star VV Cephei.—For the last thirty years the star VV Cephei was recognized to be a variable whose brightness was fluctuating between 4·9 and 5·6 magnitudes. Little was known about the nature of its variation and the star was classified as an irregular variable. In an interesting paper (*Harvard Circular* 421) Dr. Gaposchkin has discussed in detail all the available photometric and spectroscopic observations obtained at various places during the last forty years. He concludes that the star is an eclipsing binary with a period of 20·4 years. The system, he finds, consists of a supergiant red star of M-type spectrum and a smaller blue star of spectral type B. The giant star has a diameter 2,400 times that of the Sun and a mass 44·5 times the Sun's mass. The smaller component whose diameter is only one-hundredth of that of the larger, has a mass, equivalent to 35·4 times the mass of the Sun. The supergiant star appears to be about five times larger than the largest star yet known. The approximate distance of the system is estimated to be one thousand parsecs.

T. P. B.

RESEARCH ITEMS.

Organolites.—The phenomenon of base exchange has been known since 1850, but the commercial exploitation of these reactions has been confined almost entirely to zeolites, whose use to-day is very wide-spread.

The organic or humus constituents of the soil have been investigated by several workers, from a scientific standpoint, especially as to effect of soil base exchange on plant life and soil acidity. Fischer and Fuchs suggested in 1927 the use of humates for water purification but the use of humates is not very satisfactory because of the rather low base exchange capacity. Adams and Holmes (*J. Soc. Chem. Ind.*, 1935, **1-6 T**, 54) conceived the idea of purifying water by synthetic resins prepared from polyhydric phenols and formaldehyde. This is probably the first instance of a truly synthetic organic base-exchange material. It has been suggested that all such base-exchange substances of organic origin be called 'organolites', to distinguish them from the inorganic zeolites. H. Burrel has recently prepared several improved forms of organolites (*Ind. and Eng. Chem.*, 1938, **30**, 358) which have the advantages of cheapness, high exchange capacities, etc., over the phenol aldehyde type. They are prepared by rendering initially water-soluble wood extracts, especially those of the tannin type, insoluble by treatment with concentrated acids, such as sulphuric acid. They will exchange either sodium or hydrogen ions for calcium or magnesium, and exhibit some increase over initial capacity with each of the first few regeneration cycles. M. A. G. RAU.

Speed of a Deer Fly.—"On 12,000 foot summits in New Mexico I have seen pass me at an incredible velocity what were certainly the males of Cephenomyia. I could barely distinguish that something had passed—only a brownish blur in the air of about the right size for these flies and without a sense of form. As closely as I can estimate, their speed must have approximated 400 yards per second," wrote Dr. Townsend in an article to the *Journal of New York Entomological Society*. This statement of his has been referred to several times in newspapers. *The New York Times*, in an Editorial commenting on a new sea-plane record of 300 miles per hour, warned man not to be too boastful of his accomplishments and referred to the findings of Dr. Townsend regarding the speed of the deer fly. (Also *vide Illustrated London News*, January 1938.) Irving Langmuir (*Science*, 1938, **87**, 233) has considered this question carefully and has concluded that a speed of 400 yards per second (or 818 miles per hour) ascribed to the deer fly, is too large to be true, on the following grounds:—

(1) The power consumption needed to give such a speed to the deer fly works out to be about half a horse-power. To produce this power, the fly would have to consume one and a half times its own weight of food each second.

(2) The wind pressure against the head of a fly having the speed works out to be more than half an atmosphere, a pressure enough to crush the fly.

(3) Such a fly striking against human body should be able to penetrate deep into human flesh.

(4) The speed of an object of the size of a deer fly which would appear as "a barely distinguishable blur in the air" is of the order of 26 miles per hour (as shown by the experiments of Langmuir).

A speed of 25 miles per hour is therefore considered as reasonable for the flight of the deer fly. K. S. G. D.

Secondary Sources of Rubber.—*Heva Braziliensis*, the chief source of the world's present supply of rubber, being a tropical tree and therefore confined to the possessions of one or two European countries, the fear of a monopoly and desire for self-sufficiency has led other nations to experiment with several rubber-yielding plants which can be grown in temperate climates also. Contrary to the belief that these require the tropical sun to make them economic producers of rubber, recent studies in the U.S.S.R. point to the possibility of establishing plantations of these plants on a wide scale in temperate and even in cold climates. Russian research workers have studied 130 different kinds of rubber-yielding plants both in regard to acclimatisation and rubber content and the following among them have been found most promising, in the regions of Central Asia and the Caucasus:—Guayule, *Parthenium argentatum*, Eucommia, *Eucommia ulmoides*, some plants belonging to the Scorzonera (Tau Sughya) and Taraxacum (Kok-Sughyz and Krym-Saghyz genera) *Apocynum venetum* (Kendir), *Asclepias cornuti* (Vatocnik), Chondrilla and Solidago. Cultivation methods, methods of propagation, improvement by selection and crossing rubber-containing tissues, rubber content and other factors have all been studied and the results summarised (*Mon. Bul. Agri. Sci. Pract.*, Rome, December 1937).

Two pure lines of guayale have been obtained from the varieties *angustifolium* and *argentatum* and these have yielded rubber at the rate of 100 kgs. per hectare. One-year old plants have yielded from 68·5 to 85·1 kgs. per hectare and two-year old plants upto 186·3 kgs. per hectare. Plantations of over 200 hectares are said to have been established. The Eucommias yield gutta and a normal yield of 360 kgs. of gutta per hectare from one-year old plants is estimated. The Kok-Saghyr and the Kryus-Saghyz yield rubber of somewhat inferior quality, and the latter is estimated to yield from ·15 to ·2 tons rubber per acre. The Kendir of which 10,000 hectares are cultivated yields from the 3rd year onwards and upto its 10th year. The Tan-Saghyz of which some 14 million plants are found growing over an area of 20,000 hectares is interesting in the ease with which the rubber is extracted. The roots, which are the chief rubber-containing tissue, are ground to powder; this powder is thrown into water, when the rubber separates out by gravitation. The effect of manuring, irrigation and other factors, and the yield and quality of the rubber are all being studied and before long it looks as if the Soviet may be able to derive a good portion of their rubber requirements from local supplies.

Some Aspects of Modern Geology Discussed.

IN the Geology Section of the recent Jubilee Session of the Indian Science Congress presided over by the eminent Indian geologist Mr. D. N. Wadia of the Geological Survey of India, many important papers were read and valuable discussions held, dealing with several aspects of modern geology. There was a large and representative gathering of geologists including Professors of Geology from almost all the Indian Universities, and Officers of the Geological Surveys in various parts of India. There were also present some of the foremost geologists from abroad, as part of the foreign delegation, such as Prof. P. G. H. Boswell, O.B.E., D.Sc., F.R.S., Professor of Geology, Imperial College of Science and Technology, London, Dr. A. L. du Toit, D.Sc., F.G.S., Consulting Geologist of Johannesburg, S. Africa, Prof. W. G. Fearnsides, F.R.S., Prof. of Geology in the University of Sheffield, Sir L. L. Fermor, O.B.E., D.Sc., F.R.S., Former Director of the Geological Survey of India, Prof. W. T. Gordon, D.Sc., Professor of Geology in the King's College, London, Prof. F. K. Morris, Ph.D., Professor of Geology, Massachusetts Institute of Technology, Mass., U.S.A., and Prof. H. H. Read, D.Sc., Prof. of Geology in the University of Liverpool. The visiting geologists took a keen interest in the papers presented, and participated freely in the discussions, thus contributing to make the proceedings lively, useful and stimulating. The following is a brief account of some of the discussions and symposia held during the session.

Chronological Testimony of Fossil Plants and Animals.

Under the joint auspices of the sections of Geology and Botany, a symposium on "Discrepancies between the chronological testimony of fossil plants and animals" was held on Tuesday, 4th January 1938. Dr. A. L. du Toit, the well-known geologist of S. Africa, presided.

Prof. B. Sahni (*Lucknow*) in opening the discussion referred to the increasingly important part played by fossil plants in the age determination of strata, and said that the apparent discrepancies between the chronological testimony of fossil plants and animals were mostly of our own creation—due to such factors as incorrect identification of fossils, the absence of sufficiently detailed and accurate observations in the field, etc. In all cases where stratigraphical position of a bed has been accurately noted in the field, and where the fossil plants and animals collected from that particular horizon have been investigated correctly, no discrepancy is ever noticed between their chronological testimony. In support of his conclusions, Prof. Sahni referred to a number of cases in Indian stratigraphy where there was supposed to be a discrepancy between the chronological testimony of fossil plants and animals, and after examining in detail the evidence in each case, showed how recent and more definite studies of the fossils and their exact position in the bed from which they have come, have made it clear that there is really no discrepancy of any kind. In fact it is not likely that a real discrepancy can ever exist between the chronological testimony of fossil plants and animals.

Mr. D. N. Wadia (*Calcutta*) referred to four instances in India where there appeared to be a discrepancy in the testimony of fossil plants and animals—(1) the Po series of Spiti Himalayas, (2) the agglomeratic slate series of Kashmir, (3) the Gondwanas of the East Coast, and (4) the Deccan inter-trappean beds. Of these, he said, that except in the case of (3), the discrepancies were of minor significance, and can probably be accounted for as due to varying conditions of sedimentation, bad preservation, etc. In some cases, a real discrepancy may arise due to a lag in the rate of evolution of plants and animals in widely separated areas. He was of opinion that stratigraphic data carefully collected in the field, should be given prime importance in dealing with all such cases of discrepant testimony.

Dr. M. R. Sahni (*Calcutta*) supported the view that there are no real discrepancies between the evidence of the plant and animal fossils. Detailed work has shown that the apparent discrepancies are merely due to such factors as (*a*) imperfection of the geological record, (*b*) misinterpretation of this record because of insufficient data, (*c*) incorrect determination of fossils, (*d*) conclusions drawn from purely geological evidence in the absence of fossils, and (*e*) even inadvertent mixing of fossil-collections from different horizons. He amplified and substantiated these points with reference to three important formations in India where such discrepancies are supposed to exist: (i) the Deccan trap, (ii) the Gondwana rocks, and (iii) the Po series; and showed that the alleged discrepancy in each case may be explained, as due to one or the other of the above factors. Dealing with the question—do faunas and floras evolve at different rates?—Dr. Sahni was of the opinion that to suggest that marine animals evolved more rapidly than plants owing to differences in environment and organic structure, and so gave rise to discrepancies was not altogether justified by facts.

Dr. A. L. du Toit (*S. Africa*) in concluding the proceedings, pointed out that the apparent discrepancies in the dating of formations by means of their respective marine and terrestrial fossils can be ascribed to a number of factors such as, for instance, (1) the uncertainties pertaining to the geological system—boundaries either locally or regionally, whereby correlation-errors are introduced, (2) evolutionary changes during migration along extended paths whereby widely parted faunas could become 'homotaxial' instead of synchronous, correspondences in stratal succession not necessarily implying contemporaneity in deposition, and (3) climatic, oceanographic, orogenic and other influences that have affected in different degrees or senses the life of the seas and lands, and impressed themselves differently on the marine and terrestrial biota. He particularly stressed on another vital factor, *viz.*, continental drift. He pointed out how there was probably a creeping of the condensed land masses of Laurasia and Gondwana, over a revolving core, on the whole southwards during

the Devonian and Carboniferous, when the motion became reversed with some anti-clockwise rotation as well. Thus arose a progressive shift across the face of the earth of the main climatic zones, and the progress of such a climatic "wave" would naturally result in changes of biological environment, and therefore of evolutionary influences. He concluded by saying that although the marine fossils would generally constitute a fairly consistent geological clock, palæo-botanists should have no hesitation in stressing the plant evidence, should the latter be weighty, although at the moment, their conclusion may be at variance with that drawn from the associated marine faunas.

Several other valuable contributions were received for this symposium by such eminent geologists and palæontologists as Prof. W. Gothan (Berlin), Dr. T. W. Stanton (Washington), Prof. T. D. A. Cockerell (Colorado), Prof. E. W. Berry (Baltimore), Prof. H. C. Sze (Nanking) and Dr. A. B. Walkolm (Sydney); but in the absence of the authors, these communications had to be taken as read.

Boundary Faults in The Sub-Himalayas.

"The Significance of Boundary Faults in the Sub-Himalayas," was the subject of an interesting discussion held on Wednesday, 5th January, under the presidentship of Mr. D. N. Wadia of the Geological Survey of India.

Mr. P. Evans (*Assam*) referred to the hypothesis developed by Middlemiss following up a suggestion of Medlicott, which postulates that the faults within the tertiary strip of the sub-Himalayas are 'boundary faults' marking very closely the original limits of deposition of the successive groups. This conception of 'boundary faults' is still accepted as the orthodox interpretation of the structure and stratigraphy of the sub-Himalayan zone. But the recent detailed mapping in Assam has shown that the Disang thrust fault of the Naga Hills is not a south-eastern limit of deposition as suggested by the 'boundary fault' hypothesis. This and some other considerations seem to point to the need for the re-examination of the evidence on which the hypothesis is based. An alternative explanation which may be offered is that the faults are in the main of post-miocene age, largely contemporaneous, and have no close connection with the limits of deposition of the eocene and miocene beds. The object of the discussion is to consider the evidence for and against these two explanations, and it seems impossible to obtain any clear picture of the Himalayan mountain-building movements until such a fundamental contradiction is resolved.

Mr. D. N. Wadia (*Calcutta*) said that geotectonic work in the Punjab sub-Himalayas helped to define the real boundary of the Himalayas, *i.e.*, the limit of the geo-synclinal deposits against the epi-continental and fluviatile deposits laid down on the marginal foreland, and which have been involved in the later subsidiary phases of upheavals. This boundary is a well-defined thrust-plane, and the term 'main boundary fault' applied to this fault, is clearly a misnomer. South of this thrust-plane are a system of more or less parallel reversed faults which appear to be true 'boundary faults' as conceived by Medlicott and Middlemiss, and these are highly characteristic of the Punjab, Kumaon, and Garhwal Siwaliks. At the western and eastern ends of the Himalayan arc, the characteristics of the boundary faults change, and they cease to be original limits of deposition marking the southwardly advancing foot of the Himalayas at the successive uplifts. The old conception that the faults mark cliff faces of the southern front of the Himalayas, against which piles of sub-montane sediments were laid down, could only be true in a very limited and general sense at the most typical localities.

Prof. P. G. H. Boswell (*London*) agreed with the views expressed by Mr. Evans and doubted whether any 'boundary faults' of the kind conceived by Medlicott and Middlemiss, ever existed in India or elsewhere; for instance, he said that such a term was never used in describing the structure of the Alps. He did not think that these faults had anything to do with the original limits of deposition.

Prof. F. K. Morris (*U.S.A.*) also concurred with Mr. Evans, and Prof. Boswell, and said that there is no reason to believe that these faults in the sub-Himalayas mark the original limits of deposition of successive beds, as implied by the term 'boundary fault' used by Indian geologists.

Sir L. L. Fermor said that the term 'boundary fault' had better be used in the more general sense as merely indicating a fault that forms the 'boundary' of a formation, without implying any idea of its indicating an original limit of deposition.

The Origin of Banded Gneisses.

A symposium on this subject was held on Friday, the 7th January, under the Chairmanship of Mr. D. N. Wadia, President of the Geology Section.

Mr. B. Rama Rao (*Bangalore*) opened the discussion and gave a brief account of the several types of banded gneisses recognised in Mysore. These, he said, may be broadly classified into 3 divisions: (1) banded ortho-gneisses, (2) banded para-gneisses, and (3) banded composite gneisses. In group (1), the banding is due to several causes such as the parallel orientation of coloured minerals in deformed granitic rocks, the acid injection along the planes of weakness of the hornblende schists, incorporations of streaks and stringers of the dark hornblende schists in the granitic rocks, etc. Under group (2) there are rocks like the sillimanite-cordierite-gneiss, and the kyanite-sillimanite-gneiss, where the banding is due to the crystallisation of different layers of original sediments. Among (3) the banded composite gneisses, may be mentioned certain garnetiferous miaceous gneisses and cordierite-hypersthene-gneisses where the banding is seen to be due to lit-par-lit injections of acid veins in the original sediments.

Dr. M. S. Krishnan (*Calcutta*) referred to the banded gneisses observed in the Gangpur-Ranchi area of Chota Nagpur, and said that there were three types of these, *viz.*, biotite-gneiss, calc-gneiss, and amphibolite-gneiss, in all of which the lighter bands were of aplitic or granitic material injected into the rocks in lit-par-lit fashion. He drew the attention of the

house to the recent experimental work of Goranson (of the Geophysical Laboratory, Washington) which shows that pegmatite and aplite crystallise within a temperature range of 700° to 500° C. and quartz veins at still lower temperatures. Thus granitic magmas at a depth of a few kilometers can be expected to give sufficient residual fluids to soak or to penetrate porous and schistore rocks in their neighbourhood, and give rise to granitization and banding.

Mr. L. S. Krishna Murthi, Dr. C. Mahadevan, and Mr. Syed Kazim (*Hyderabad-Deccan*) in a joint communication gave an account of the banded gneisses they had studied in Raichur and Gulburga Districts, and said that the banding in these gneisses may be classed under two heads:—(1) banding in the grey series produced by aplitic and pegmatitic phases of the same series, and from injections of the pink series and (2) banding in both the grey and the pink series, produced by long runs of basic rocks, as seen in the contact zones of the schists and gneisses.

Prof. H. H. Read (*Liverpool*) put forward the view that all the banding in the gneisses and such other rocks is inherited from the original country rock, which itself already had some kind of banding; and that this original banding had, to a great extent, determined and controlled the nature of the banding in the derived gneisses. Often it is a case of an original sedimentary banding being reproduced in the metamorphic gneiss. He said he was not particularly happy about the term 'injection gneiss' since, in a way, the term begs the question. The idea of lit-par-lit injection, he said, is really applicable only in very few cases of rocks formed under very special conditions; and he did not believe that in any of the banded gneisses referred to by the previous speakers, there was a true case of banding due to injection of acid igneous material through basic rocks like hornblende schist; they appeared to him to be all due to the igneous metasomatism of an original already banded rock.

Prof. F. K. Morris (*U.S.A.*) from his knowledge of such banded rocks in America, and also parts of India, agreed entirely with the views of Prof. Read, and said that the term 'lit-par-lit injection' had better be altogether abandoned; and similarly also even the term 'injection'. The entire process involved may appropriately be called 'guided replacement'. He then referred to certain aspects of 'metamorphism' and showed how starting form shale, it was possible to derive schists, banded gneisses and even granites.

Dr. A. L. du Toit (*S. Africa*) supported the views of Prof. Read and said that the idea of replacement in the production of banded gneisses is being more and more recognised. The present orthodox nomenclature in describing these banded rocks should be abandoned, and we must also cease to think that high pressure was responsible for producing banding and contortion. The change from a sedimentary bed to a banded gneiss could be effected at a fairly low temperature and a relatively low depth.

Pre-Cambrian Sedimentation.

An interesting symposium on 'Pre-Cambrian Sedimentation' was held on Sunday, 9th January. Mr. D. N. Wadia, President of the Geology Section, was in the chair.

Sir L. L. Fermor in opening the symposium, said that the term 'Pre-Cambrian' in such a discussion must be used in the more general sense so as to include all the period of time before the deposition of the Cambrian strata. He gave a brief review of the pre-Cambrian rocks of India, and drew pointed attention to some of the special features noticed among these formations, for many of which, he said, satisfactory explanations have yet to be put forward.

Prof. L. Rama Rao (*Bangalore*) discussed a few aspects of pre-Cambrian sedimentation in general. After pointing out a number of facts which one has to remember in discussing any aspect of pre-Cambrian geology, he said that in the study of pre-Cambrian sedimentation, three questions naturally come up for consideration: (1) what was the appearance of the face of the earth at the beginning of geological history; was there a world sea encompassing the whole earth, or were there, as now, continental blocks and sundering oceans? (ii) was the character and composition of these primeval oceans, and of the atmosphere under which they lay, the same as it is now; and were the processes of sedimentation, chemical, mechanical and organic, similar to those of the present day? and (iii) what part, if any, did life play in the building up of these ancient rocks? In dealing with the second question, he discussed how far a rigid adherence to the doctrine of uniformitarianism is reasonable or helpful in interpreting the past history of the earth during this prolonged period of remote antiquity covered by the pre-Cambrian. Regarding question (iii), he said that, taking into account all considerations, there seems to be no doubt that many more forms of life flourished in the pre-Cambrian period than the actual fossil record indicates. The pre-Cambrian seas must have been teeming with life of a kind which could never be preserved in the fossil condition, but nevertheless played an important part in initiating and directing the course of contemporary sedimentation.

Mr. B. Rama Rao (*Bangalore*) talking about the main features of sedimentation of the Archæan times as exemplified in the Dharwar rocks of South India, said that the process of sedimentation of this extensive era may be considered under three periods: (1) the oldest period when there was a dominance of vulcanism with hardly any sedimentation; the few probable sediments are of the nature of chemical depositions—mainly siliceous; (2) during the second period, there are evidences of there having existed meteoric conditions, more or less similar to those of the present day; there was still a considerable amount of chemical deposition, lime, iron and silica being the common products of precipitation; (3) this last period indicates conditions of sedimentation not very different from what are commonly seen at the present day; the disintegrated products of rocks were transported, sorted, and deposited like the present-day sediments.

Dr. M. S. Krishnan (*Calcutta*) said that, of the sedimentary types in the pre-Cambrians, the iron formations and the manganiferous rocks are peculiar in that their deposition has not

been repeated in later ages to a similar extent or magnitude. After giving a brief account of the nature and distribution of these deposits in India, he said that though iron and manganese occur in close association in rocks and minerals, on going into solution, they tend to be segregated during deposition—the abundance of oxygen determining whether carbonates or oxides will be deposited.

Prof. H. H. Read (*Liverpool*) believed that the conditions of pre-Cambrian sedimentation were more or less the same as those of later times, and saw no reason to appeal to any 'non-uniformitarian' principle. He said that almost all the rock types of the pre-Cambrian period are matchable among post-Cambrian formations, except the biogenic rocks of the latter.

Prof. P. G. H. Boswell (*London*) said that according to the idea of uniformitarianism as modified by Sollas, it is possible that the dynamical agents, though they have never varied in kind, may have still varied in the intensity of their action during former geological periods; and this will probably serve to explain all aspects even of pre-Cambrian geology. Talking of the limestones, he said that in their formation, it is often very difficult to draw a line between chemical precipitation and organic origin—the two agencies were so closely intermixed. It is quite probable that life played quite an important part in their deposition. The iron ores, which form such a unique feature of the pre-Cambrian in many parts of the earth, very probably owe their origin to the action of bacteria. Algæ and bacteria were the two groups of primitive life which seem to have played a large part in pre-Cambrian sedimentation. He thought a spectroscopic analysis of pre-Cambrian graphites may throw some light on their origin.

Prof. W. G. Fearnsides (*Sheffield*) said that in reviewing earth history in general, it will be seen that each major formation has some particular type of rock constituting its speciality. In the case of the pre-Cambrian, the iron ores occupy this position. These must have been formed due to a peculiar combination of special conditions.

Prof. F. K. Morris (*U.S.A.*) talking of the life of the pre-Cambrian, said that the highly organised character of Cambrian life makes it absolutely necessary to believe in a long process of evolution of pre-Cambrian life from the primitive unicellular condition to the Cambrian stage. We should also realise that the protozoan cell itself is really not so simple and primitive a structure as it is commonly believed to be; it is a most complicated structure, and must itself have been derived as a result of an equally long process of evolution from much smaller and simpler specks of life which may be termed 'moleculobiontia'. There is no doubt that the pre-Cambrian seas were literally teeming with life which must have played a large part in the formation of contemporaneous marine deposits.

L. Rama Rao.

The Tenth Conference of the Indian Mathematical Society.

THE Tenth Conference of the Indian Mathematical Society was held at Lucknow under the auspices of the Lucknow University on the 15th, 16th and 17th of March 1938. Dr. R. P. Paranjpye, the Vice-Chancellor of the Lucknow University, served also in two other capacities as the Chairman of the Reception Committee and as the President of the Indian Mathematical Society. In his welcome address, Dr. Paranjpye referred to the good and continually enlarging sphere of work done by the members of the Society, and laid emphasis on the need for a detailed scheme of work regarding the History of Mathematics in India. He pointed out that the Indian Mathematical Society was pre-eminently fitted to make authoritative investigations in this field, and suggested that the Society should immediately set to work in this direction.

The Conference was declared open by the Hon'ble Mr. Govind Vallabh Pant, Premier of the United Provinces, in an *extempore* and exceedingly humorous speech, in the course of which he referred to the outstanding contributions of early Indian Mathematicians, such as the introduction of the decimal system. The Premier expressed the hope that the holding of the present Conference of the Society at Lucknow would serve as a stimulus to the progress of mathematical research in the U.P.

Dr. R. Vaidyanathaswamy of the Madras University, then delivered the Presidential Address on the 'Philosophical Foundations of Mathematics'. A full text of his address will appear in the *Mathematics Student* in due course.

About forty papers dealing with diverse mathematical topics were presented to the Conference, and many of them elicited useful discussions on the subject. Besides these, a symposium was held on the 'Relative Merits of Einstein's and Sulaiman's Theories of Gravitation,' the symposium being led by Sir Shah Sulaiman, Prof. Narlikar and Prof. A. C. Banerjee. There was also a brief address by Prof. Vijayaraghavan on Tauberian Theorems.

There was also a brief discussion as regards methods of teaching mathematics. Finally, as regards the systematisation of research on the history of mathematical development in India, a Select Committee was constituted to draw up a report to be submitted to the Committee of the Indian Mathematical Society.

Three popular lectures, meant for the general public, were delivered: "The Theories of Gravitation," by Sir Shah Sulaiman; "Stars and Galaxies," by Prof. A. C. Banerjee; "Properties of Numbers," by Prof. T. Vijayaraghavan.

The Conference was attended by delegates from almost all parts of India. The success of the Conference was due to the enthusiasm of Dr. R. P. Paranjpye, assisted by Prof. Strang, Dr. A. N. Singh and a band of energetic volunteers.

SCIENCE NOTES.

Arctic Exploration.—Results of great scientific importance are expected from the data collected by the daring Soviet Arctic Explorers, M. Papanin and his three comrades, who, in their drifting ice flow successfully covered twelve hundred miles in a period of 258 days. This expedition will go down to history as one of the most striking in recent years both for organisation and achievement. For exploring the inner polar regions, the Soviet authorities followed Nansen's idea of taking advantage of the drift of ice—not to move or try to move against the ice but with it. The members of the expedition had few things to perform beyond their scientific observations. The rate of movement of the flow will give the rate of the current and the rate of overflow of Arctic water to the Atlantic. Meteorological and magnetic data at high latitudes have been collected. Regular soundings of the Ocean have also been taken. Besides these, important observations have been made on the winter phases of the plankton and on the physics of the ocean water below the ice, such as the charting of the intermediate warm layer of Atlantic water and its relation to ice formation and wastage. It is expected that the results of the expedition will soon become available to science.

High Soviet Titles were conferred on the four Polar Scientists, Papanin, Krenkel, Shirshot and Federov who were each awarded a money prize of 30,000 roubles.

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The Rangala Meteorite.—At the Ordinary Monthly Meeting of the Royal Asiatic Society of Bengal held on 4th April, Dr. Cyril S. Fox of the Geological Survey of India, exhibited 2 meteoric pieces which fell at about 10 A.M. on the 29th December 1937, near Rangala about 32 miles north-northwest of Marwar Bhinmal Railway Station in Jodhpur State, Rajaputana. The meteor is reported to have fallen as one piece which broke in fragments on impact with the ground and made a crater, 1½ feet in diameter and over a foot deep. Only two moderately large and several small fragments have so far been secured by the Chief Minister, Government of Jodhpur. He has very kindly forwarded these to the Geological Survey of India, and is endeavouring to procure more from the village people who had collected specimens after the fall.

"The noise of the meteroite appears to have been heard at Bhinmal from the direction of Bagora, which is on the way to Rangala, and this may refer to the actual impact. The same evidence was forthcoming when enquiries were made at Bagora where it was stated that a noise was heard of the arrival of a celestial body which came to earth with terrific force near Rangala. The villagers of Rangala were frightened by the meteorite which they thought to be a bomb from an aeroplane. They stated that it arrived with great speed and crashed and broke into hundreds of pieces and made a hole four feet deep.

"The two larger pieces exhibited weigh 1,670·32 grams. The material is being studied by Dr. J. A. Dunn, and is a stone meteorite which he tentatively classifies as a 'white chondrite', containing olivine, enstatite, nickel-iron and the iron sulphide triolite. A few patches of thin fused crust have been preserved on the broken specimens received. It is interesting to note that there is a decided concentration of metallic minerals in this crust. Thin veins of similar mineral matter penetrate the meteorite."

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***Kayakalpa* or Rejuvenation.**—Remarkable success has been achieved by Tapsi Bishundas Udasi, a follower of Guru Nanak (who has practised *Kayakalpa* on himself and whose present age is about 172 years) who recently rejuvenated Pandit Madan Mohan Malaviya, the Founder-Vice-Chancellor of the Benares Hindu University, by his remarkable Kayakalpa treatment. The Pandit who is 76 years old, has completely recovered from the effects of old age—weakness, loss of memory, etc. The improvement in his general health is reported to be remarkable. The treatment which lasted for 45 days, was strictly in accordance with the rules laid down in Chapter 39, 7th *Ashtanga Hridaya*. The Pandit was placed in a closed dark chamber on a strictly controlled diet. The medicine, administered, was prepared by a long process in a forest and required four herbs, which were dried, powdered and used as a coating for a certain quantity of "aonla" placed inside the hollowed trunk of a palas—*Ficus religiosa* tree, and ashed after piling several maunds of cow-dung cakes.

Rajguru, Pandit Hardutt Shastri (62 years) old) of Tehri (Garhwal) State also underwent the same treatment with remarkable benefit.

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Imperial Veterinary Research Institute, Muktesar.—The *Annual Report* for the year ending March 31, 1937, which has just been issued, shows that important investigations with equine and fowl diseases have been carried out at the Institute. The National Home Breeding Association donated a sum of Rs. 3,000 to the Institute for the furtherance of investigations into equine diseases, and a like sum was also given to the Military Veterinary Laboratories for a similar purpose. These amounts were pooled together for carrying out systematic researches on the causes of sterility in mares. Work is also being continued on diseases of the horses known as *encephalomyelitis*.

Researches on goat pneumonia, goat and sheep pox, etc., are being carried out.

A new product of the Institute—the anti-Anthrax Spore Vaccine—has been prepared for issue in the field. The seed material was obtained from the Director of Veterinary Services, Burma, and the vaccine prepared following the method which is in vogue in South Africa. Tests with this vaccine have been eminently satisfactory.

It is hoped that in the near future the Institute will be able to issue another product, a *Tetanus antitoxin* the work on the manufacture of which is in progress.

The Institute has interested itself in investigations on the nutrition of cattle and other animals

by means of feeding experiments deficient in minerals and vitamins. The object of the experiments is to determine, if possible, to what extent certain diseases can be prevented or ameliorated by feeding of balanced rations to the animals.

The causal organism of swine plague *Pasteurella suis* has been isolated. The Protozoology Section of the Institute has interested itself with the study of the *trypanosomiasis*, *coccidiosis*, *Piroplasmosis*, etc., and in connection with the last named, it is of interest to note that a parasite, *Babesia bovis*, appears to have been identified for the first time in this country. It is becoming increasingly evident that this branch of veterinary science is of the utmost importance and the co-operation of entomologists and protozoologists should eventually lead to results of far-reaching importance.

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National Academy of Sciences, India.—With a view to placing definite proposals regarding power supply before the Government of the United Provinces, which if given effect to, would ensure cheap and abundant supply of electric power, thus assisting in the development of industries, the following resolutions moved by Prof. M. N. Saha, F.R.S., were unanimously adopted at a meeting of the National Academy of Sciences held at Allahabad, on 29th March.

1. That the Government is requested to appoint a Committee consisting of eminent lawyers, scientific experts and representatives of industry to study the present Electricity Act and to recommend necessary legislation required to nationalise the generation and distribution of electricity with a view to making the supply of electrical power in these Provinces cheap and abundant.

2. That the Government is requested to elect a body of graduates in physics and electrical and chemical engineering to study the methods of construction of Power Station and the organisation of generation and distribution of electrical energy in foreign countries like England, Russia and Switzerland. It is desirable that the body should consist of an expert and experienced electrical engineer who will be in charge of a batch of students to study different aspects of the question, *i.e.*, two for studying constructional details, one for studying the methods of distribution of electricity, one for studying the economics of production and distribution, and others to study industries which are absolutely dependent on cheap supply of electricity.

3. That the Government is requested to appoint a permanent body called the "Power Survey and Research Institute" to study the natural sources of power existing within or in the neighbourhood of the Province. The person in charge of the above body should be a competent electrical engineer with experience and knowledge of the different branches of science, *viz.*, Physics, Fuel Engineering and Hydro-electric engineering which are required for such kind of survey work.

4. That the National Academy of Sciences, India, will be prepared to furnish details with reference to the resolutions mentioned above.

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Catalogue of Mathematic Publications.—The Central Library of the University of Calcutta has undertaken the compilation of a catalogue of all mathematical publications, books and periodicals, available in the major libraries of Calcutta, for the benefit of the research students of mathematics. For this purpose the Imperial Library, the Library of the Geographical Survey of India and the Library of the Royal Asiatic Society of Bengal have agreed to co-operate with the University Library. The work of compilation has already been started. After the completion of this catalogue, the Central Library proposes to take up similar compilations, dealing with other scientific subjects.

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Indian Academy of Sciences.—The Third Annual Meeting of the Academy was held on the 24th March at the Indian Institute of Science, Bangalore, with Sir C. V. Raman, Kt., F.R.S., N.L., in the chair.

The following distinguished scientists were elected Honorary Fellows:—

(1) Prof. Peter Debye, Berlin; (2) Prof. F. G. Donnan, London; (3) Prof. R. T. Leiper, London; (4) Prof. Tullio Levi-Civita, Rome, and (5) Prof. N. I. Vavilov, Leningrad.

Dr. R. Ananthakrishnan, Dr. F. R. Bharucha, Mr. C. B. Mohendra and Mr. T. C. Sahni were elected Fellows.

Sir C. V. Raman was re-elected President and Professors B. S. Madhava Rao and C. R. Narayan Rao, Hon. Secretaries.

The President delivered a lecture on the "Physics of the Solid State".

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Indian Chemical Society.—At the Ordinary Meeting of the Society held on 22nd March, at the University College of Science, Calcutta, with Rev. Father J. Van Neste, S.J., in the chair, the following were admitted as Fellows:—

(1) S. S. Cowlagi, B.Sc. (*Bombay*); (2) A. C. Rothenhein, Esq. (*Bombay*); and (3) Prof. Md. Qudrat-i-khuda, D.Sc. (*Calcutta*).

Dr. Umaprasanna Basu, D.Sc., delivered a lecture on "Mineral Elements in Nutrition".

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Botanical Society of Bengal.—The Second Annual General Meeting of the Society was held on Wednesday, the 23rd February, at 5 P.M., at the Botanical Laboratory, Calcutta University. Prof. S. C. Mahalanobis, President of the Society, took the chair.

The Secretary presented the Annual Report.

The Society is now considering the steps to be taken to start a Journal.

An excursion to the Royal Botanic Gardens, Sibpur, was organised by the Society, during the year.

On the occasion of the Silver Jubilee Session of the Indian Science Congress, the Society organised an exhibition and conversazione and a lunch at the Grand Hotel to meet the Foreign Delegates and Indian Botanists from outside Bengal.

The Society is organising a branch of the Society at Dacca.

Prof. S. C. Mahalanobis was re-elected *President* and Dr. J. Sen Gupta and Mr. A. K. Ghosh, *Honorary Secretaries*.

The Biological Control of Insect Pests.—In a somewhat popular account of the interesting subject of the Biological Control of Insect Pests (*Agriculture and Live-stock in India*, 7, No. VI). P. V. Isaac draws attention to several successful instances where serious insect pests have been kept down by the introduction of beneficial insect parasites such as of the Lady-bird beetle, *Rodolia cardinalss* Muls., first from Australia into California to keep down the Cottony Cushion scale insect on citrus trees, and later into South Africa, Portugal, Italy and other countries for the same purpose; (2) of the predatory bug *Cyrtorhynus mundulus* Bredd, from Australia into Hawaii to keep down the sugarcane leaf-hopper *Parknisiella saccharicida* Kirk; (3) of the parasite *Porspaltella berlesi* How., from the U.S.A. into Italy to control the mulberry scale insect *Diaspis pentagona* Targ; (4) of the Tachinid fly, *Ptychomyia remota* Ald., from the Federated Malay States into Fiji for the control of the cocoanut leaf-eating pest, the caterpillar of the moth *Levuana iridescens* Beth-Backer and (5) to the large scale artificial rearing for multiplication and release of the *Trichogramma minutum* Riley, against the sugarcane borer pest. The view regarding the limited scope for biological control that it cannot succeed in continental areas but only in island countries and again that it can succeed only with introduced pests and parasites and not with indigenous ones is controverted and the instance of the successful use of the sugarcane borer parasites in Mysore is quoted in support. The transference of native beneficial insects from one section to another of continental areas is indicated as promising. The importance and the effect of new methods and the human agency generally in overcoming the limits which nature may be deemed to have set is emphasised and attention drawn to the successful use of artificial breeding methods, cold storage and so on which help to release the beneficial insects just when they may be wanted.

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University of Bombay: Royal Institute of Science.—Dr. T. S. Wheeler has been re-elected to the Council of the Indian Academy of Sciences as Vice-President. He also represents the Academy as Vice-President on the Council of the National Institute of Sciences.

Prof. G. R. Paranjpe, I.E.S., has been nominated by the Government of Bombay to be a Member of the Court of Visitors of the Indian Institute of Science, Bangalore. Prof. Paranjpe has also been re-elected Vice-President of the Indian Physical Society.

Dr. F. R. Bharucha has been elected a Fellow of the Indian Academy of Sciences.

Dr. Y. G. Naik has obtained the degree of Ph.D. in Physics of the Bombay University.

"The aim of Science is to find out the one great principle which has caused the world phenomena. It seeks to demonstrate the underlying unity amidst the diverse and conflicting facts of Nature. In this, I think, Religion and Science do not contradict each other, but actually coalesce." This is the gist of an inspiring message by the Hon'ble Mr. B. G. Kher, Premier of Bombay, in the latest number of the *Royal Institute of Science Magazine*.

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University of Mysore—I. *Personnel*: (*a*) Mr. J. C. Rollo, M.A., J.P., Principal, Maharaja's College, Mysore, has been granted combined leave of absence in continuation of the summer vacation for two months and 29 days from 24th June 1938 and Mr. A. R. Wadia, B.A., Bar-at-Law, Professor of Philosophy, Maharaja's College, Mysore, appointed to act as Principal during the period.

(*b*) The Vice-Chancellor of the University has kindly consented to be the representative of this University on the Inter-University Board for the next period of three years from 1st April 1938.

(*c*) Dr. B. Sanjiva Rao, M.A., Ph.D., Professor of Chemistry, Central College, Bangalore, has been deputed to the Tenth International Chemical Congress to be held at Rome in May 1938 and granted privilege leave from the 24th June 1938 to the 11th July 1938 in continuation of the summer vacation.

II. *Meeting of the Senate*: The Annual Meeting of the Senate was held on the 26th March 1938. Among the propositions that were passed besides the budget for 1938-39, mention may be made of the following:—(*a*) Adoption of the Report of the Post-Secondary Diploma Courses Committee and the course of studies and scheme of examinations for the several subjects. (*b*) Recommendations to Government for the amendment of the University Act so as to give power to the University to affiliate institutions within the State. (*c*) Revised detailed courses of study for the B.T. Degree Examination. (*d*) Revised courses of study in History for the B.A. Honours Degree Examination. (*e*) Revised courses of study in Economics for the B.A. Honours Degree Examination.

III. *General*: The Geographical Association, Madras, has been invited to hold the Summer School in Geography at Bangalore in April 1938 to which certain teachers of the University and of the Department of Public Instruction are deputed.

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Lucknow University.—At a meeting of the Executive Council of the University of Lucknow, Mr. Sheikh Mahomed Habibullah, M.L.A., was unanimously elected Vice-Chancellor, in place of Dr. R. P. Paranjpe, who will be retiring in September 1938.

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University for Peshawar.—The Central Assembly passed without a division on April 1, the resolution moved by Mr. Abdul Qaiyum, recommending to H.E.H. the Governor-General in Council, that a University subsidised by the Federal Government be at once set up at Peshawar for the settled districts and tribal areas of the North-West Frontier Province.

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Universities in U.P.—The Government of the United Provinces have decided upon setting up a Committee to make a comprehensive enquiry into the working of the Universities of the U.P. The need for the co-ordination of activities of the Universities and the necessity for avoiding duplication is emphasised. The Committee will *inter alia* inquire into the merits of the unitary and residential type of universities and the extent to which these two

types have succeeded in spreading knowledge, encouraging research and influencing the character of the students. The Committee will also investigate the need for a Provincial Board to regulate grants, powers of the University authorities and the amenability of universities to popular control.

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Prof. Meghanath Saha, F.R.S., Professor of Physics, Allahabad University, has accepted the chair of Palit Professor of Physics in the University of Calcutta.

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Prof. N. R. Dhar of the Allahabad University has been appointed Deputy Director of Public Instruction, United Provinces.

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(Miss) **Kamala Bhagvat, M.Sc.,** a member of the Indian Federation of University Women, has been chosen as a member of the delegation representing the International Federation of University Women at the "Conversazione" of the International Institute of Intellectual Co-operation at Luxemburg, which will take place between 22nd and 25th May.

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The Diploma of Honour and the Scientific Medal of Merit have been conferred on **Prof. Bhola Nath Singh, D.Sc.,** Kapurthala Professor of Plant Physiology and Agricultural Botany, Benares Hindu University, by the Congregation of the Academia de Sciencias e Artes, Rio de Janeiro, Brazilian Republic.

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Cenco-Schilling Wave Properties Apparatus.—A new and large-scale apparatus has recently been devised by means of which, using short sound waves, the phenomena of reflection, interference and diffraction, etc., of sound waves can be demonstrated. The central component of the apparatus is the "accoustic radiator" consisting of a whistle of variable pitch (6,000 to 12,500 cps.) which serves as the point source of 'monochromatic' sound waves. This is mounted at one end of a long open-ended chamber, the walls of which are lined with sound-absorbing materials so that the sound issuing from the open end is uncontaminated by reflections. A special microphone and a special associated amplifier which is connected to a cathode ray oscillograph through a coupling unit are also provided. The microphone is mounted on an optical bench carriage, so that it can be used as a detector and the positions of maximum response determined on the scale of an optical bench. With the acoustic radiator are supplied, a variety of diaphragms with circular apertures and slits of different sizes and spacings; opaque and semi-opaque reflectors, mounted on rods to fit optical bench carriages; a diffraction grating, both transmission and reflection; and several kinds of reflection objects. With these accessories experiments can be performed which are completely analogous to those on reflection, refraction and interference of light. Further information regarding this apparatus can be obtained from Messrs. Central Scientific Company, Allahabad, who are the agents for the Central Scientific Co., in India.

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Announcements.

The Council of the **National Institute of Sciences of India** has decided, to hold in Bombay on September 26th and 27th next, a Symposium on recent work on "the Synthesis of Naturally Occurring Substances". It is hoped that all organic chemists who have worked on the subject will send their papers early in August to Dr. T. S. Wheeler or Dr. Mata Prasad at the Royal Institute of Science, Bombay. Papers should be submitted by or through a Fellow.

The Third International Cancer Congress.—Under the auspices of the International Union against Cancer, the Congress will be held in the United States of America from September 11 to 16, 1939, at the Haddon Hall Hotel, Atlantic City, N.J. The President of the Congress is Professor Francis Carter Wood, Director of the Institute of Cancer Research, Columbia University, New York City; Dr. Donald S. Childs, of Syracuse, N.Y., is the Secretary-Treasurer, and Dr. A. L. Loomis Bell, of Long Island College Hospital, Brooklyn, N.Y., is in charge of transporation and exhibits. The proposed sections are as follows: General Research; Biophysics; Genetics; General Pathology of Cancer; Surgery of Cancer; Radiological Diagnosis of Cancer; Radiotherapy of Cancer; Statistics; Education. Further details concerning sectional chairmen, committees and other data will be announced later. The membership fee will be $15. All inquiries should be addressed to the Institute of Cancer Research, 1145, Amsterdam Avenue, New York, N.Y. (*Science*, 1938, **87**, 186).

A Research Fellowship in either biological or geological or meteorological science is offered by the **Women's College of the University of Sydney, Australia,** for two years. The value of the Fellowship is £200 per annum with free residence in the College and a grant towards passage money of not more than £50 each for the outward and return voyage. Further particulars can be obtained from the Honorary Secretary of the Indian Federation of University Women, 31, Pedder Road, Cumballa Hill, Bombay.

Ophthalmological Society of the United Kingdom.—The Ophthalmological Society of the United Kingdom has instituted a Treacher Collins Prize of £100, which will be awarded every three years for the best essay submitted on a subject selected by the Council of the Society. It will be open to medical practitioners of any nationality, but the essay must be written in English. The first subject selected is *Cerebro-spinal disease and its relation to the optic nerve.* Essays should be submitted to the Honorary Secretary of the Society at 5, Racquet Court, Fleet Street, London, E.C. 4., before December 31, 1938.

* * *

We acknowledge with thanks, receipt of the following:—

"Agricultural Gazette of New South Wales," Vol. 49, No. 3.

"Journal of Agricultural Research," Vol. 55, Nos. 11 and 12.

" Agricultural College Magazine, Nagpur," Vol. 12, No. 3.
" Indian Journal of Agricultural Science," Vol. 8, No. 1.
" Monthly Bulletin of Agricultural Science and Practice," Vol. 29, No. 2.
" Agriculture and Live-Stock in India," Vol. 8, Part 2.
" The Philippine Agriculturist," Vol. 26, No. 10.
" Allahabad Farmer," Vol. 12, No. 2.
" Biochemical Journal," Vol. 32, No. 2.
" Berichte Der Deutschen Chemischen Gesellschaft," Vol. 71, No. 3.
" Chemical Age," Vol. 38, Nos. 973-77.
" Calcutta Medical Journal," Vol. 33, Nos. 3-4.
" Current Titles from Engineering Journals," Vol. 2, No. 2.
" Experiment Station Record," Vol. 78, No. 2.
" Transactions of the Faraday Society," Vol. 34, No. 203.
" Indian Forester," Vol. 64, Nos. 3-4.
" Forschungen und Fortschritte," Vol. 14, Nos. 6-9.
" Genetics," Vol. 23, No. 1.
" Journal of the Royal Society of Arts," Vol. 86, Nos. 4448-52.
" Journal of Chemical Physics," Vol. 6, No. 3.
" Journal of the Indian Chemical Society," Vol. 15, No. 1.
" Journal de Chemie Physique," Vol. 35, No. 1.
" American Museum of Natural History," Vol. 41, No. 3.
" Nature," Vol. 141, Nos. 3564-3568.
" Journal of Nutrition," Vol. 15, No. 3.
" Canadian Journal of Research," Vol. 16, No. 2.
" Journal of Research, National Bureau of Standards," Vol. 19, No. 6.
" Sky," Vol. II, No. 5.
" Indian Trade Journal," Vol. 128, Nos 1655-59.

Catalogues.

Cambridge University Press : Books for Spring 1938.

Weldon & Wesley Ltd., " Monthly List of Books, on Natural History and Science ", February-March. 1938.

" Verlag von Gustav Fischer in Jena ", No. 2, 1938.

ACADEMIES AND SOCIETIES.

Indian Academy of Sciences :

March 1938. SECTION A.—B. V. RAGHAVENDRA RAO : *Dispersion of Acoustic Velocity in Liquids.*—Dispersion in the hypersonic region is definitely established in the case of two liquids carbon tetrachloride and acetone, by interferometric measurements. S. CHOWLA : *On a Trigonometric Sum.* P. SURYAPRAKASA RAO, C. VENKATA RAO AND T. R. SESHADRI : *Chemical Examination of* Erythrina indica.—A fixed oil and a water-soluble alkaloid (hypaphorine) have been isolated from the seeds. The barks and leaves have also been examined to contain the same base. L. A. RAMDAS AND P. S. VAIDYANATHAN : *Studies on the spreading of certain substances on a clean surface of water. Part I.*—With a soluble substance like camphor, the phenomena of surface solution and internal solution have been studied quantitatively. R. ANANTHAKRISHNAN : *Effect of temperature on the Raman Spectrum of Liquid* CCl_4. While the ratio of the intensities of the Stokes and anti-Stokes lines tend to approach unity with increasing temperature in accordance with Placzek's theory, there is no corresponding increase in the absolute intensities of the Stokes and anti-Stokes lines as is to be expected from the theory. It is suggested that the effect of the unharmonicity of nucler vibrations and the centrifugal stretching of the molecule due to rotation, is probably responsible for this departure from the expected increase in intensity. A. VEERABADHRA RAO : *Effect of Oblique Refraction at the Prism Surfaces on the Relative Intensities of Raman Lines.*—It is shown that if illumination from the side is adopted, the intensity of the well-polarised lines is apparently diminished in relation to the unpolarised ones, and the reverse, if illumination from the top is adopted. G. R. GOGTE : *Chemistry of β-Aryl Glutaconic Acids, Part IV.*—*C-Acetylation of β-Aryl glutaconic Anhydrides : Derivatives of α-Aceto-β-aryl-glutaconic Acids.* P. PATTABHIRAMAYYA : *A Study of the Raman Effect in Sodium Nitrate.*—The changes with temperature in the Raman lines obtained with a large single crystal have been studied. P. PATTABHIRAMAYYA : *The Dispersion and Optical Anisotropy of Molecular Oxygen in Relation to its Absorption Spectrum.*—A new dispersion formula for gaseous oxygen has been worked out, which is simultaneously able to explain the observed optical anisotropy of the oxygen molecule and its dispersion. S. BHAGAVANTAM : *Specific Heats of Liquids in Relation to Raman Effect Data.*—The specific heats of liquid benzene, CCl_4 and CS_2 are calculated with the help of the known fundamental frequencies in each case at different temperatures. It is concluded that in liquids, thermal movements of molecules are partly in an organised manner constituting Debye elastic waves as in a solid, and partly in a random manner as in a gas. P. G. N. NAYAR : *Raman Spectrum and Constitution of Pentaerythritol.*—The spectrum corresponds to a tetrahedral symmetry ; the O—H frequency is characteristic of the presence of hydrogen bonds.

March 1938. SECTION B.—B. P. PAL AND NEK ALAM : *The Effect of Certain External Factors upon the Manifestation of Hybrid Vigour in Wheat.*—Studies relating to hybrid vigour in a cross between two varieties of *Triticum vulgare, viz.*, Pusa 52 and Pusa 165, under different dates and times of sowing, different depths of sowing and different conditions of sowing. M. K. SUBRAMANIAM : *Sudies on the Structure of the Golgi Apparatus.*—Confirms the previous observations that the double-rimmed Golgi batonettes originate from vesicles, thus conclusively showing that the idiosome forms only a core to the double-rimmed batonettes. There appears to be a fundamental plan in the Golgi apparatus common to all cells, vertibrate or invertibrate, and the different patterns in different

cells when analysed resolve into variations of a single basic procedure. J. DAYAL: *Studies on the Trematode Parasites of Fishes. A New Trematode* Neoganada barabankiæ *(Nov. Gen., Nov. Sp.) from* Clarias batrachus. J. DAYAL: *A New Trematode* Phyllochorus macronius, *N.Gen., N.Sp. belonging to the Family* Gorgoderidæ *Looss* (1910), *from the Body-cavity of a Fresh-water Fish* Macrones tengara. B. N. SINGH, G. P. KAPOOR AND R. S. CHOUDHRI: *The Light Factor in Crop Production.*

National Academy of Sciences, India:

March 29, 1938.—J. DAYAL: *On a New Species of the Genus Astriotrema Looss* (1901) *from the Intestine of a Fresh-water Fish,* Clarias batrachus. M. ABDUL SALAM: *On the Occurrence of* Skrajbinema ovis (Skrajbin, 1915) *in India.* SATYA PRAKASH AND S. B. DUTT: *Colour and Chemical Constitution of the Organic and Inorganic Salts of Di-phenyl-violuric Acid.* V. L. VERMA AND S. B. DUTT: *Condensation of Di-phenyl-thiobarbituric Acid with Aldehydes, Quinones and Nitroso Compounds, Indigoid Dyes Derived from Chrysoquinone.*

Indian Association for the Cultivation of Science:

December 1937.—P. C. MUKHERJI: *On the Relation between the Emission Spectra of* Nd^{+++} *ions in Phosphorus and the Absorption Spectra of the same in Crystals.* D. S. SUBRAHMANYAM: *Verification of Stokes' Theory of a Sphere Oscillating in a Liquid.* M. SEN GUPTA: *On the Theory of Semi-Conductors in Magnetic Field.* JAGANNATH GUPTA: *A Note on (CH) Vibration in Sodium Formate.* SURIAN SINGH SIDHU: *Technique for making Collodion Filter for the* K_α *Chromium Radiation.* K. PROSAD AND R. P. GUPTA: *An Application of the Ray-Displacement Refractometer to the Study of Anomalous Dispersion of Didymium Glass.* S. C. SIRKAR: *On the Intensities of Raman Lines due to Lattice Oscillations.* SURIAN SINGH SIDHU: *The Calculation of Interplanar Spacings of Crystal System by Vectors.*

Indian Chemical Society:

January 1938.—J. C. GHOSH: *The Physico-Chemical Properties of Ascorbic Acid.* C. A. ROTHENHEIM, H. S. SHAIK MAHAMUD AND S. S. COWLAGI: *Vitamin C contents of Indian Food-stuffs. Chillies* (Capsicum). SISIR KUMAR GUHA: *Dyes derived from Acenaphthenequinone, Part VI.*—2-(4-*Methyl*)-*thionaphtheneacenaphthyleneindigos.* C. J. DASA RAO, D. G. WALAWALKAR AND B. S. SRIKANTAN: *On the Anthocyanin Pigment in the Rind of Sugarcane (Purple* Mauritius). S. K. MITRA: *Thioketonic Esters. Part V.* JAMAIT V. LAKHANI AND RUSTAM P. DAROGA: *The Determination of the Parachors of Inorganic Salts in Solutions and their Structure. Part I.—Potassium Salts.* SUSIL KUMAR RAY: *Determination of Parachor in Solution. Part II.—Parachor of Inorganic Salts in Aqueous Solution.* MATA PRASAD AND R. N. MERCHANT: *Study of the Crystals of* p-*Nitroaniline and* p-*Nitrotoluene by the X-Ray Single crystal Rotation Method.* MATA PRASAD AND A. B. KHAN: *Space Group Determination of the Crystals of* Ortho- *and* Para-Benstoluides *by the X-ray Rotating Crystal Method.* S. K. MITRA: *On Thioaldehydes and Thioketones, Part II.* CHUHARMAL S. NARWANI AND NALEJAR B. SIDHWA: *Optical Inactivity of Gelatin in the Adsorbed State at the Liquid/Liquid Interface and its Use as a Measure of Adsorption.* PHULDEO SAHAY VARMA AND V. SUBBA RAO: *Halogenation, Part XX.—Halogenation of Fluorene.*

Botanical Society of Bengal:

March 30, 1938.—S. N. BAL: *Some Medicinal Plants of Kashmere.* S. MEYER: *Studies in the Family Apocynaceæ.*

Society of Biological Chemists:

March 4, 1938. (Bangalore).—B. SANJIVA RAO AND K. S. SUBRAMANIAM: *Essential Oil from* Hemidescus indicus *(Indian Sarasaparilla).* K. V. GIRI AND N. S. DOCTOR: *The Use of Pyrophosphate in the Determination of Vitamin C Content of Plant and Animal Tissues.* K. V. GIRI: *Spectrophotometric Study of a New Colorimetric Method for Vitamin C.* C. N. ACHARYA: *Interference of Soil in the estimation of Cellulose.*

March 14, 1938. (Indore).—Y. D. WAD AND L. N. DESAI: *Variation in Seed Composition of Crop Plants. Part I.—Influence of Soil and Climate.* V. G. PANSE: *Application of Statistics to Biological Experiments.*

March 17, 1938. (Bombay).—B. B. DIKSHIT: *The Formation of Acetyl Choline by the Tissues.* V. N. PATWARDHAN AND R. G. CHITRE: *The Effect of Hypervitaminosis D on Calcium and Phosphorus Metabolism in the Albino-rats.*

Meteorological Office Colloquium, Poona:

February 25, 1938.—Dr. V. I. Vaidyanathan (Irrigation Research Institute, Lahore), addressed the Colloquium on "The Applications of Physics to Problems of Irrigation". He referred to the various ways in which the physicist could be of practical assistance to the Irrigation Engineer and described some interesting experiments conducted at the Institute.

March 22, 1938.—Dr. S. N. Sen, "On the Mechanism of Cyclones in the Bay of Bengal, particularly from the Point of View of Deformation fields".

Errata.

Vol. VI, No. 9, March 1938.

Page 450, note entitled "The Coupling of 6-Hydroxyflavone with Diazo Salts," line 16, *for* "diazo" *read* "disazo".

Page 482, column 2, under National Academy of Sciences, para 2, last line, *for* "Evolution or Revolution in Plant Work" *read* "*Evolution and Revolution in the Plant World*".

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